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Training the Football Tackler

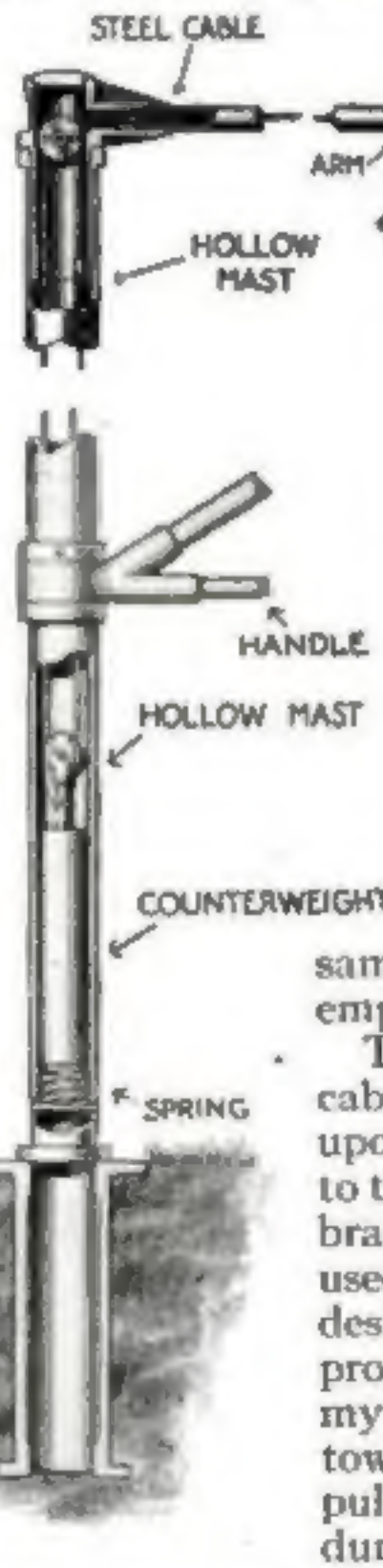
A tackling dummy which moves as if it were a live player running around the end

FOOTBALL as now played is a well-balanced, interesting game, with emphasis laid more than ever on the physical development of the players. During recent years the game has undergone refining at the hands of experienced sportsmen, with the result that open playing is encouraged in preference to the rough and tumble close formation of other seasons. The demand today is for more speed and better generalship.

Football is so strenuous a game that it may not be played without preliminary training. A thorough mastery of the sport calls for the proper coordination of brains and brawn.

A number of mechanical contrivances have been invented to harden the football recruit during his practicing season. Tackling dummies are perhaps the most numerous. They require tactics which are far removed from the actual operation of bringing a player to the ground when he is running at full speed. Throwing a lifeless figure prostrate is entirely different from tackling a moving figure.

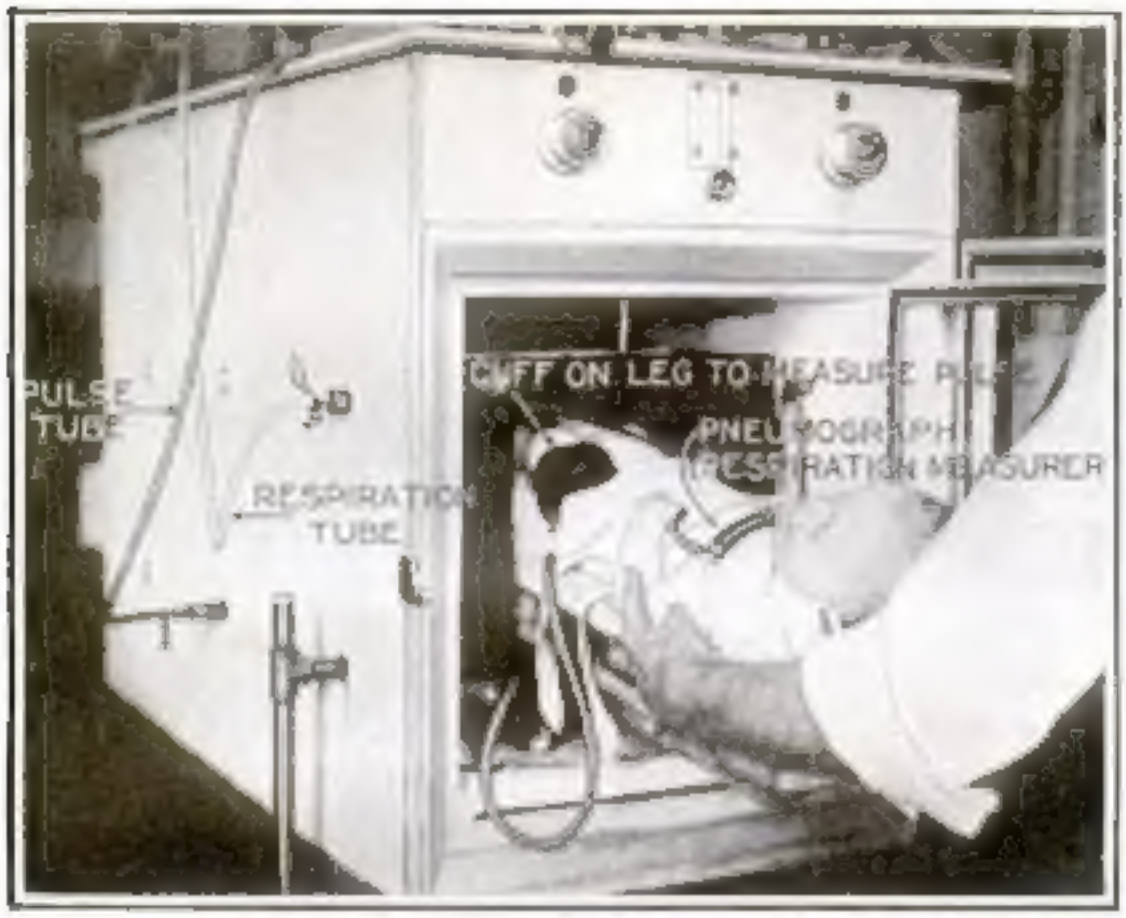
Oliphant of the "Army," the human battering ram, carried from one to four tacklers down the field with him when he was running with the ball. No amount of preliminary practice enabled players to halt his terrific rushes. It is just possible, however, that if a tackling device such as that illustrated on the opposite page had been used in teaching the players the rudiments of scientific tackling, Oliphant might have met his Nemesis.



The hollow mast and its various parts

John H. Ashton, a Brown University man, has overcome many of the most serious defects in existing tackling devices. His dummy moves exactly as if it were a live player on a quick run around the end. When the player tackles the dummy, it does not immediately fall to the ground, but furnishes a positive resistance to a downward drag, so that the player must use the same force that he would employ to down an opponent.

The dummy hangs by a steel cable from an arm mounted upon a hollow mast. Attached to the mast, at a point where a bracket meets it, is a handle, used to rotate the frame at any desired speed to impart the proper momentum to the dummy. As the player rushes toward the dummy, the coach pulls the handle, causing the dummy to swerve away from the attack. There is a counterweight in the hollow mast.



The instruments showed that underweight babies produced more heat units or possessed more horsepower than did fat babies

Measuring the Horsepower of That Baby of Yours

DR. JOHN R. MURLIN, of Cornell University Medical College, has devised an apparatus which causes a baby to record its own horsepower. Horsepower is used in this sense merely as the expression of a unit of energy. Dr. Murlin devised this apparatus for use in the study of the energy requirement of the new-born child.

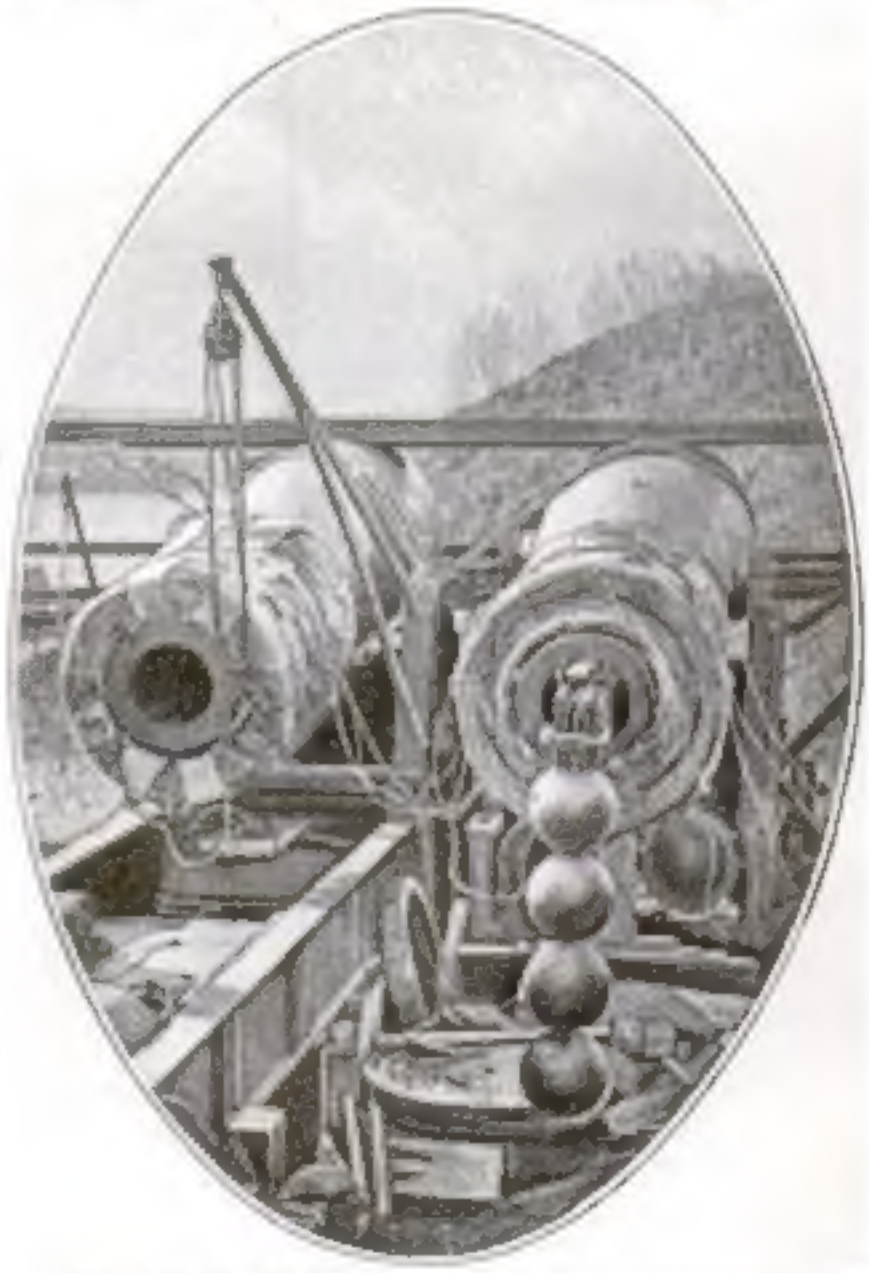
A baby unconsciously writes the story of its energy by means of its pulse and its breathing. A small cuff is attached to the left leg of the infant above the knee. From this cuff a tube leads to a glass connection, passing through the wall of the incubator and finally to a T-tube on the top of the incubator. One limb of this tube passes to an air-pump and the other to another T-tube. To the second T-tube a mercury-pressure gage (manometer) is connected by one limb and a pressure-bottle to the other. From this bottle a transmission-tube leads to a recording drum. Thus with each pulse the baby makes a record.

Oddly enough, the fattest baby produced the smallest degree of horsepower. While sleeping the babies produced an average of .004 of a horsepower. It was determined that the normal heat production of recently fed, sleeping babies between two months and one year of age is .09 horsepower.

A Magnet Made from Two Discarded Cannons

PROBABLY the largest and strongest magnet in the world is at Willett's Point, N. Y. It was made by accident. The commander of the post happened to see two old fifteen-inch Dahlgren guns lying unused side by side on the dock. He conceived of the idea of converting them into a magnet of enormous power by winding submarine cable around them.

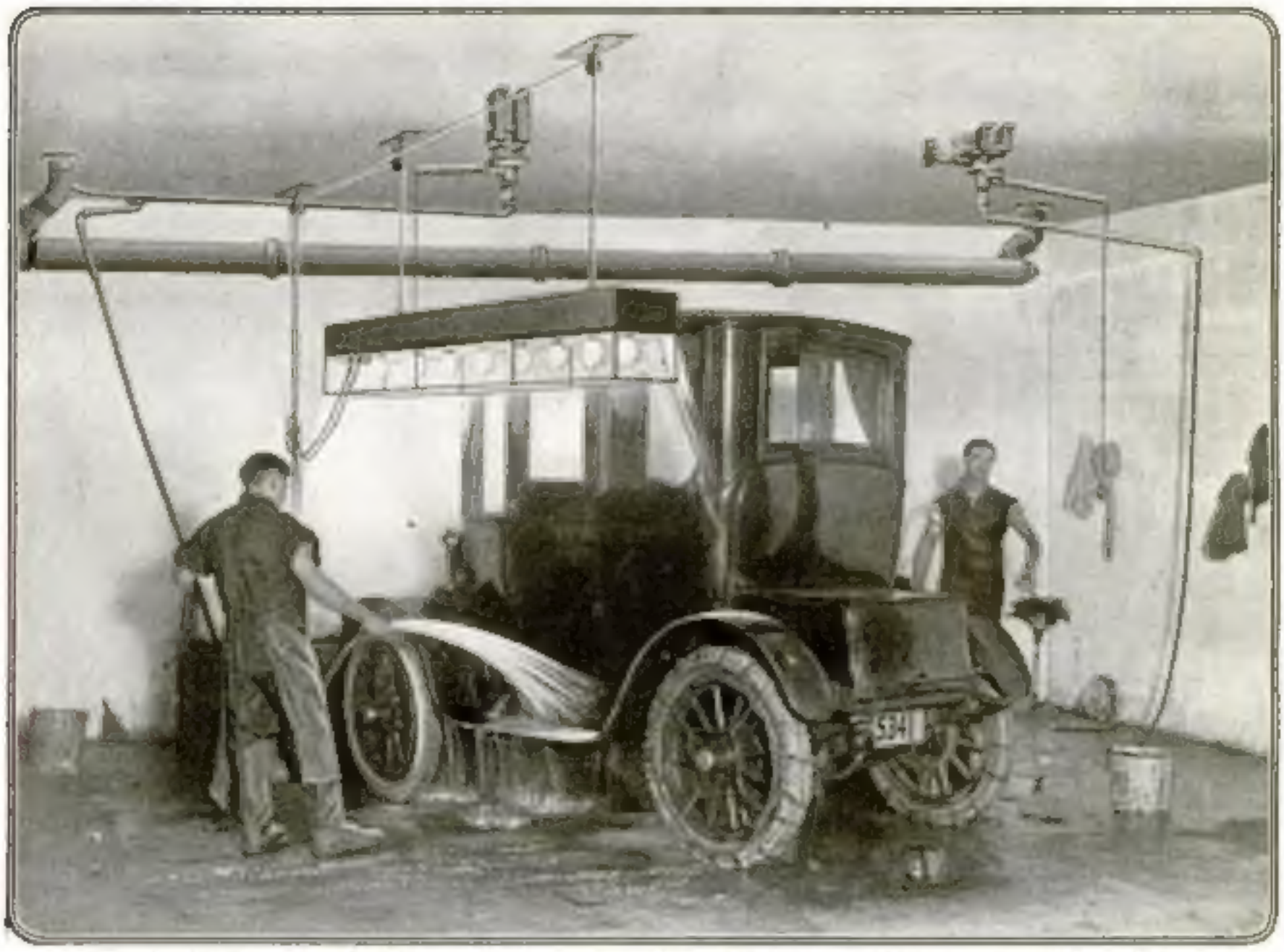
The magnet, which stands about ten feet from the ground, is eighteen feet long, and has eight miles of cable around the upper part of the guns. It takes a force of twenty-five thousand pounds to pull off the armature. A crowbar applied to the magnet requires the combined force of four strong men to tear it away.



Two 15-inch Civil War cannon converted into an electromagnet which is so powerful that it takes a force of twenty-five thousand pounds to pull off the armature

A Washstand Light for Garages

Plenty of light is needed in the garage, and so an ingenious, movable box of lights is used



A flood of light may be thrown upon any portion of the body of the automobile without subjecting the bulbs to contact with the spray. The box can be elevated to any height

THE washing of automobiles in garages which is the regular night work of the attendants, is greatly simplified by the use of the novel lighting device shown in the accompanying illustration. It is hung from the ceiling and may be moved up or down alongside the car according to the part being cleaned.

The unit consists of an enclosed tin box with eight electric-light bulbs in sockets in the bottom. On the top of the box are two hooks to which are connected two small ropes running over two pulleys which are suspended from the ceiling.

The ropes then pass to a two-sheave pulley on the side wall near the ceiling and then down to a cleat within the reach of a man on the floor. By letting out or taking in the ropes the box may be lowered or elevated to any desired height. It is kept just high enough above the parts being cleaned to prevent the water from splashing on the bulbs and breaking them.

The bulbs are further protected from injury by means of a small wire guard on the bottom of the box, as shown. The cable carrying the light current is attached to the wall with considerable slack, so that it will not interfere with the upward or downward movement of the lights.

The box containing the lights may also be laid flat on its side on an improvised stand in order to throw a flood of light underneath the automobile when repairs are to be made or when cleaning or oiling is to be done. Heretofore, individual lights enclosed in wire guards were used. This method was found dangerous.

A mechanism in the handle counts the jumps

Letting the Jumping Rope Record the Jumps

ALL the vocal gymnastics have been taken out of the youthful pastime of jumping rope. No longer will numbers be called as the prodigy next door jumps up to five hundred or more, and the chances are that "Pepper, salt, mustard, cider, vinegar," will be forgotten. Two inventors of New Brunswick, New Jersey, Edward H. Stokes and Raymond E. Grymes, have invented a jumping-rope which will automatically register the number of times it is turned. In other words, children can jump themselves to death without uttering a sound.

In a handle at one end of the jumping-rope is a counting mechanism which registers each turn of the rope. The handle is hollow so that the rope enters it and connects with the counter at the front end. A removable cap makes it possible to adjust the counter. A sight opening is provided in the side of the handle to enable the jumper to note the number of turns.

Why You Hear Well on a Clear, Frosty Night

SCIENCE says that the loudness of sounds varies inversely as the square of the distance. This is merely another way of saying that if you walk three times as far away from the source of the sound as you were before, its loudness will be not one-third what it was, but one-ninth what it was, for nine is the square of three.

On the other hand, the density of the medium which conveys sound is very important. On a frosty night the air is dense. One consequence of this is that an automobile runs better, because the engine gets larger supplies of oxygen. Another result is that sounds are heard more loudly. However, the report of a gun high up in the mountains is like the sound of an exploded firecracker. In the Colorado Rockies giant boulders are carried along by snowslides. On a warm night the slides make little noise, but on a clear, frosty night the noise is deafening.

As dangerous as it is exciting

Increasing the Thrills in Ice-Skating

SKILFUL skating on ice is difficult enough with ordinary skates but with stilt-skates, such as those illustrated, it is in a class with dangerous sports. The ice is hard enough when hit from the usual height. How must it feel when stilt-skates skid out from under you?

There are only three people in the United States who have attained proficiency in the art of skating on stilts. C. P. Muldoon, who appears in the illustration, is one of them. His stilts are twenty-four inches high and carry a steel plate at the top and bottom

There are nine parts to the skating apparatus, adjusted to suit the skater. According to those who have used stilt-skates they are just as safe as ordinary ice-skates, and they give just as much pleasure and comfort. There is no denying the fact that they afford pleasure; but as for comfort—that is for professionals.

A High-Speed Bit That Bores Without Choking

AN auger-bit has been invented with several novel constructional features. The twist is just the reverse of all other so-called double-twist auger-bits in that the bit is made very thick at the edges and thin in the center. The technical reason for this change is the generally acknowledged weakness of an auger-bit that is caused by its tendency to clog or choke when boring holes more than two or three inches in depth. The twist of an auger-bit is essentially a conveyer. The rubbing of the chip against the wall of the hole being bored causes it to be retarded and it finally packs so tight that the bit refuses to bore.

In the new type of bit the thickened edge which keeps the chip closer to the center of the bit provides ample room for chip passage.

The thread of the bit extends beyond the center of the point

Turning the Stationary Tub Into an Electric Washing-Machine

THE stationary tubs in the kitchens of our apartment houses have not simplified the task of housekeeping. Generally the tubs are so low that they make washing a back-breaking operation. For this reason, probably, stationary tubs in the more modern of our apartment houses are seldom used for washing.

With the advent of an electric washing-machine for stationary tubs, however, it looks as if the family washing might be done at home after all. A new electric washer will help in attaining that end. It is enclosed in a stationary tub and is provided with two motors, one of which is attached to the bottom of the tub. The other, which operates the wringer, is on a special platform which holds a basket, into which the clean clothes fall from the wringer.

As will be seen from the accompanying illustration, a switchboard is built into the tub between the two sets of faucets, so that it is entirely out of the reach of mischievous children.

The washer is enclosed in the stationary tub and is provided with two motors and a switchboard

Some Weather Bureau Duties We Overlook in Criticising the Weather Prophet

WHY do we have a Weather Bureau? This question is likely to be asked, in more or less querulous tones, whenever the local weather prediction fails, as it often does. The inquirer overlooks the fact that the Weather Bureau has much more important things to foretell than ordinary changes of weather. It predicts with certainty great windstorms, destructive floods, severe freezes and other atmospheric visitations that endanger life and property on a large scale and collects climatic statistics for scientific agriculture.

The Mechanics of Shoplifting

The department store parasite turns inventor and devises some ingenious tools for stealing under the detective's eye

A capacious repository—a bag sewed inside a coat

A skirt bag large enough to hold a baby grand piano—almost

The false bottom travel-bag—a Hungarian contrivance

FOR sheer cleverness the professional shoplifter deserves the iron cross of thiefdom. He or she (there are just as many men as women in this vocation), must work under the vigilant eyes of detectives. Yet shoplifters ply their trade with seeming indifference, pilfering finery that totals hundreds of thousands of dollars a year.

Although department stores reluctantly admit it, the fact is that shoplifting is as profitable as ever. There are reasons enough The professional shoplifter has his regular customers for whom he steals. The customer selects the article in the store, the shoplifter steals it, obtains a fair price for it—plus his cleverness, and the deal is closed and forgotten. It is purely a business transaction—cash only, and no questions asked. There is no dickering with a "fence" or second-hand dealer; consequently the police are thrown off the usual beaten path.

Unfortunately for our stores the professional shoplifter has found time and opportunity to turn inventor. His tools are ingenious mechanical contrivances. One of these is the false bottom, hinged-flap traveling bag, recently found in the possession of a Hungarian team—two young men and a woman.

Innocent looking in itself, the bag is a veritable storehouse for purloined articles. The thief places the bag on the counter over the article to be stolen. By leaning carelessly on it enough pressure is exerted to force the article up past the hinged-flaps into the false bottom. If the thief is apprehended the bag is opened and reveals nothing, unless the searcher suspects that there is a false bottom.

When a thief is caught with the

side-flap suitcase, conviction is almost always sure to follow. However, the contrivance is very effective in stealing ribbons, gloves, handkerchiefs and hosiery. The bag is placed on the floor and the articles are simply rolled off the

A shoplifter's sleeve rolled back to reveal the artificial third arm

A bag, sewed in the shoplifter's skirt, filled with all manner of stolen articles

counter on to the flap as the thief calmy looks the salesgirl in the eye. The flap is returned to its position by the foot.

Then there is the subtle third arm used for over a century—an artificial arm, fitted into the sleeve of the coat, which rests quietly on the counter while the real arm inside the coat is busily tucking away stolen stuff. A woman using this means to steal imported laces was arrested in Philadelphia. The published story of her arrest created a furore.

Often thieves are caught with two roasting pans wrapped in heavy paper under their arms. Of course, the paper is torn underneath and the articles deposited in the pans. False packages are not uncommon. They consist of paper wrapped around a frame. The interior is large enough to hold six dozen handkerchiefs.

There are muffs, umbrellas, long gloves, blouse-bags, skirt-bags, men's pockets with the bottom at the knee line, shoes with false soles, real babies with conveniently long dresses up which valuable are stored, and many, many others.

Stealing with a side-flap suitcase. The flap is closed by the foot

The Constant Warfare Between the Trees and the Rocks

Above: All rocks have cracks which sooner or later the rootlets of some tree search out. The rootlet may die but it leaves a little soil on which another coming later may feed. Then a seed is wafted there and real rock splitting soon begins

Above: The lower part of the trunk and the root of a juniper tree on a mountain side which is slowly but surely splitting a great boulder. The top of the tree has been broken off by the winds but the roots keep up the struggle

An aspen which is forcing apart the rock into which it is growing. The rock could probably trace back a long line of ancestors of this tree each one of which has carried on the warfare relentlessly

A portion of the roots of an upturned tree. The root system of a tree is even greater than the limbs and branches, equaling the spread of the tree

A Tree Like the Rock Which Moses Smote with his Rod

Photo Janet M. Cummings

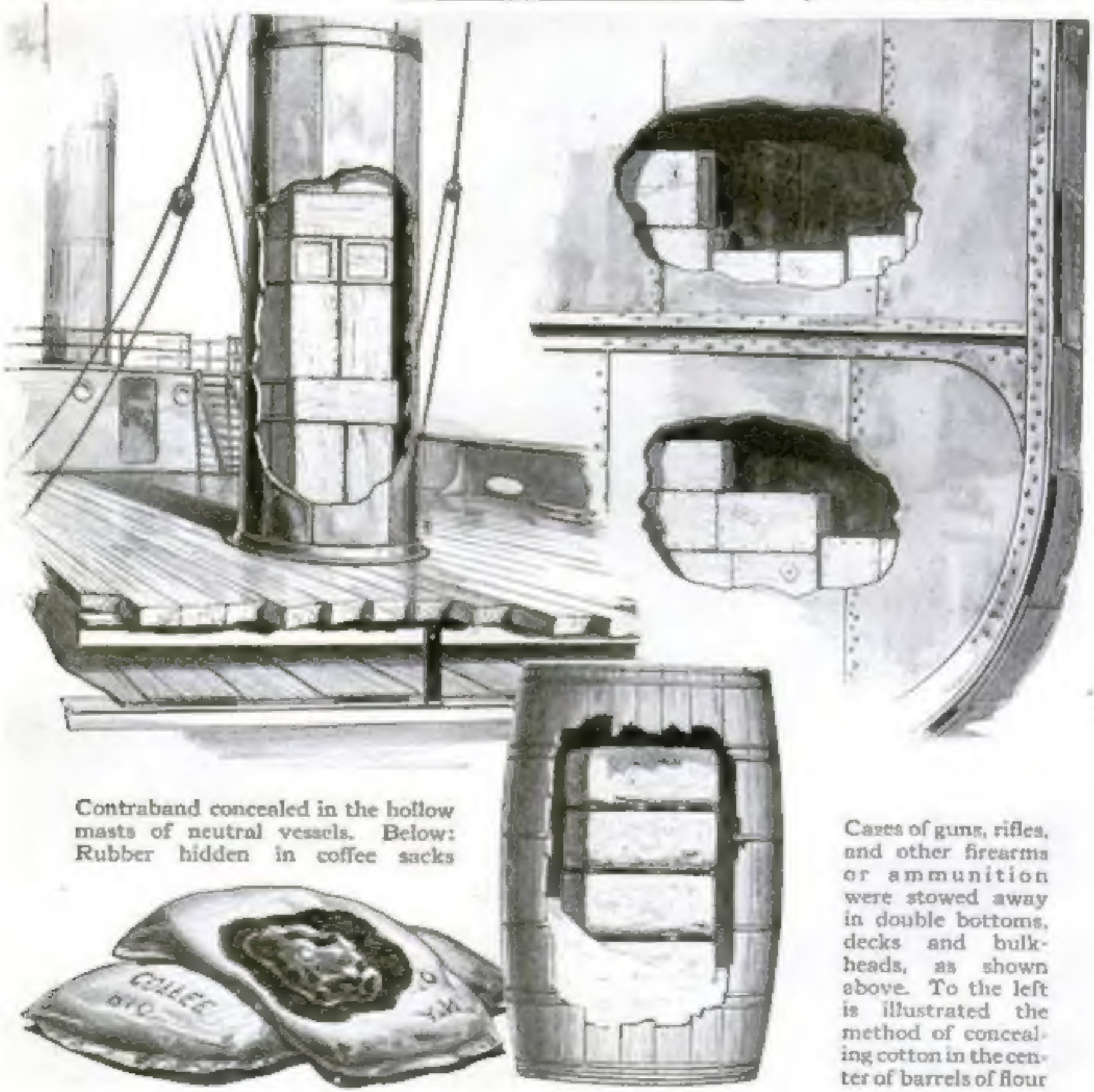
The Traveler's Tree, so called because when its stem is cut a quantity of pure, cold water spurts out, grows throughout the West Indies. Its leaves resemble those of the banana tree

The Wiles of the North Sea Blockade Runner

To deceive the British naval officers of the North Sea Blockading Fleet, shippers who used neutral vessels resorted to many ingenious devices. Thus, "rubber honey" was sent in honeycombs filled with a curious mixture

Rear Admiral Sir Dudley de Chair, Commander of the Tenth Cruiser (Blockade) Squadron in the North Sea, states that "whenever a ship is discovered to be carrying contraband, an officer and an armed guard of five men are put aboard to conduct the blockade runner into our nearest port, where examination usually takes from two to five days according to the disposition of the cargo and the consequent difficulty of removing it. The weekly average of ships passing eastward through our patrols is fifty; in summer time, about eight per cent of these are sailing vessels. . . . The British customs officers did not slide easily into new grooves. Accustomed for years to board a ship and inquire merely for dutiable wines or spirits, they were perhaps too easily satisfied. . . ."

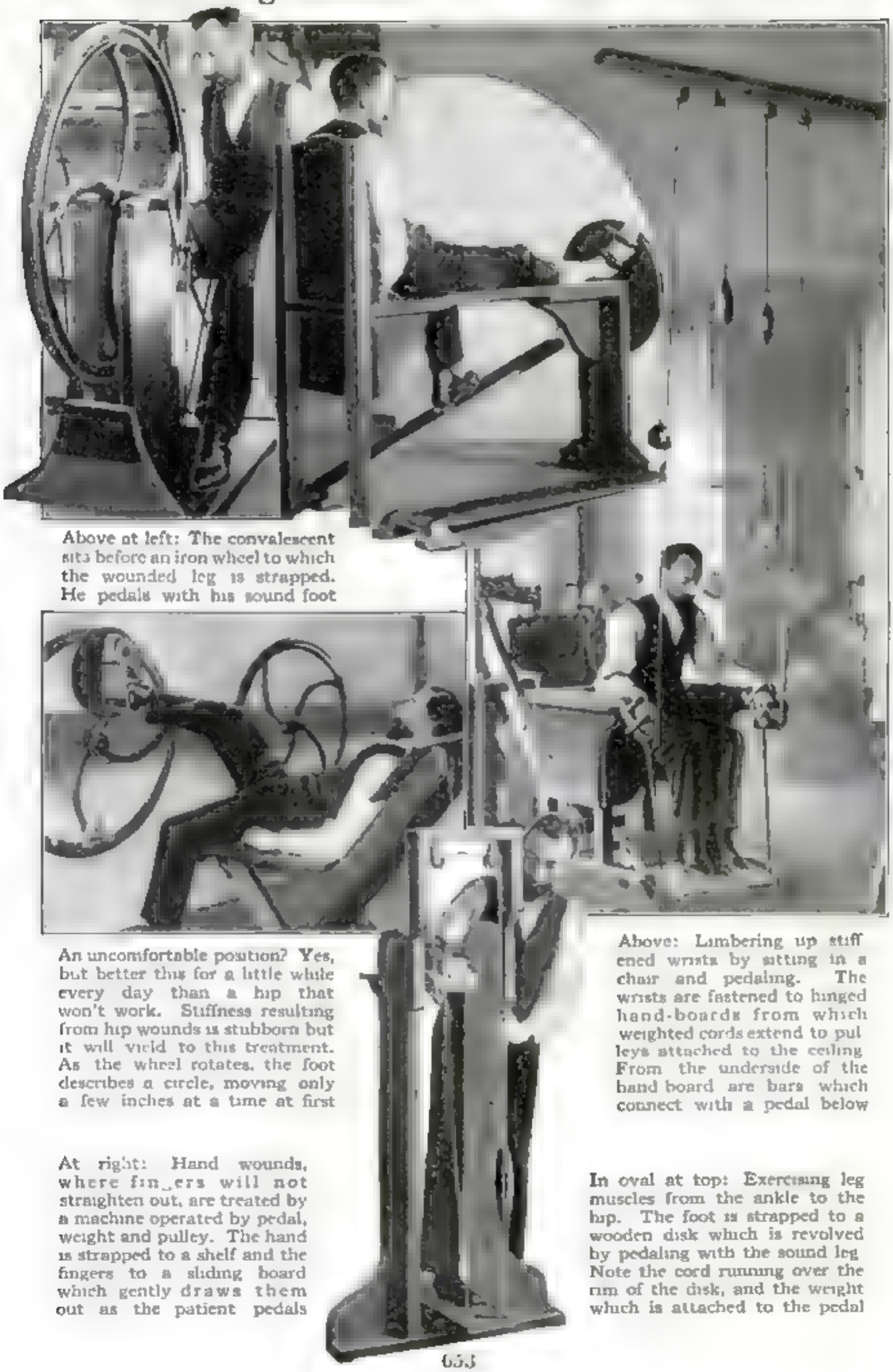
According to Rear Admiral de Chair, rubber was sometimes smuggled through in the form of onions. "These were discovered when one of our officers dropped one on the deck; the onion bounced up ten feet into the air"



Contraband concealed in the hollow masts of neutral vessels. Below: Rubber hidden in coffee sacks

Cases of guns, rifles, and other firearms or ammunition were stowed away in double bottoms, decks and bulkheads, as shown above. To the left is illustrated the method of concealing cotton in the center of barrels of flour

Exercising Machines for Wounded Soldiers



Above at left: The convalescent sits before an iron wheel to which the wounded leg is strapped. He pedals with his sound foot

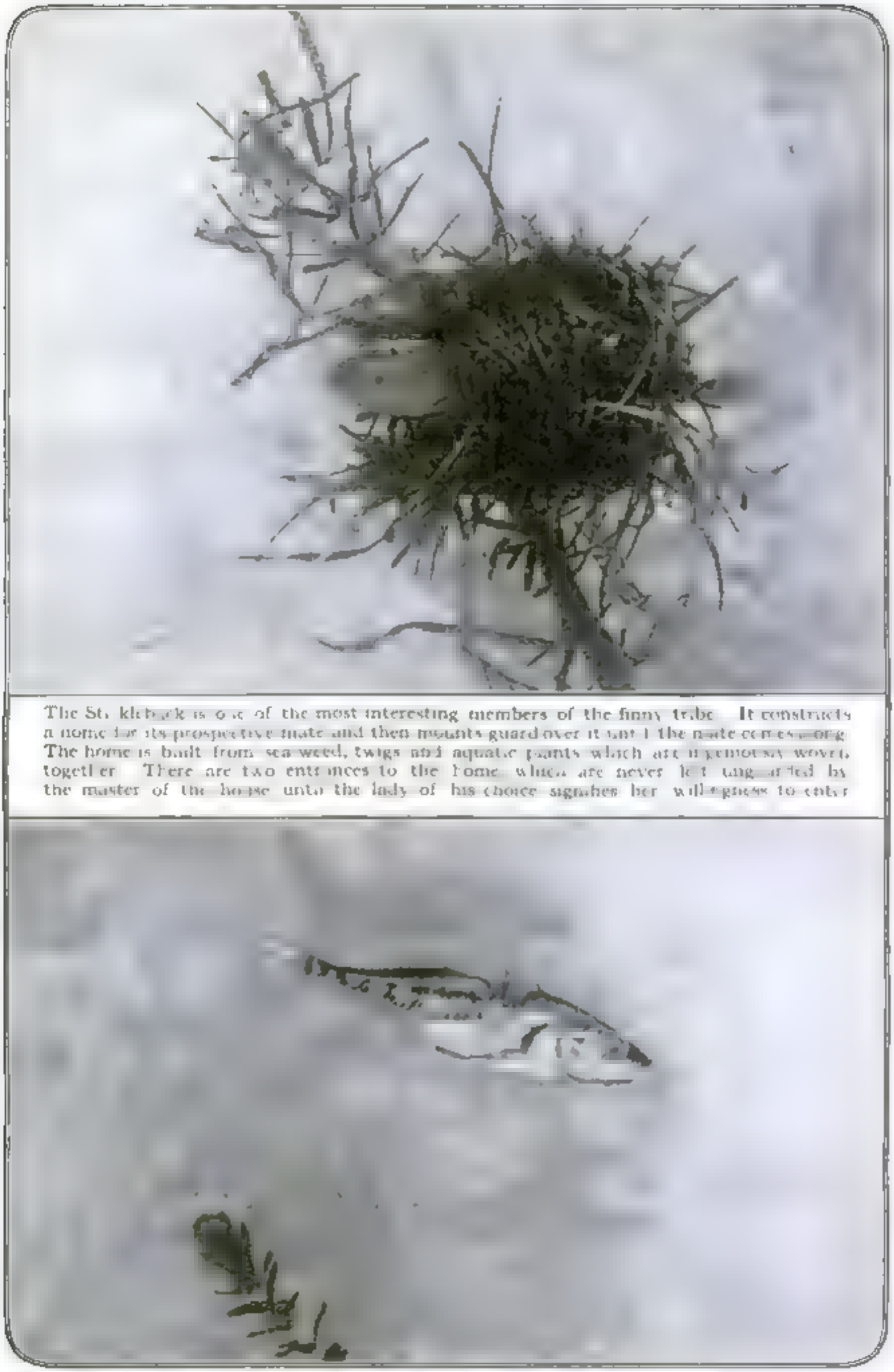
An uncomfortable position? Yes, but better thus for a little while every day than a hip that won't work. Stiffness resulting from hip wounds is stubborn but it will yield to this treatment. As the wheel rotates, the foot describes a circle, moving only a few inches at a time at first

Above: Limbering up stiffened wrists by sitting in a chair and pedaling. The wrists are fastened to hinged hand-boards from which weighted cords extend to pulleys attached to the ceiling From the underside of the hand board are bars which connect with a pedal below

At right: Hand wounds, where fingers will not straighten out, are treated by a machine operated by pedal, weight and pulley. The hand is strapped to a shelf and the fingers to a sliding board which gently draws them out as the patient pedals

In oval at top: Exercising leg muscles from the ankle to the hip. The foot is strapped to a wooden disk which is revolved by pedaling with the sound leg Note the cord running over the rim of the disk, and the weight which is attached to the pedal

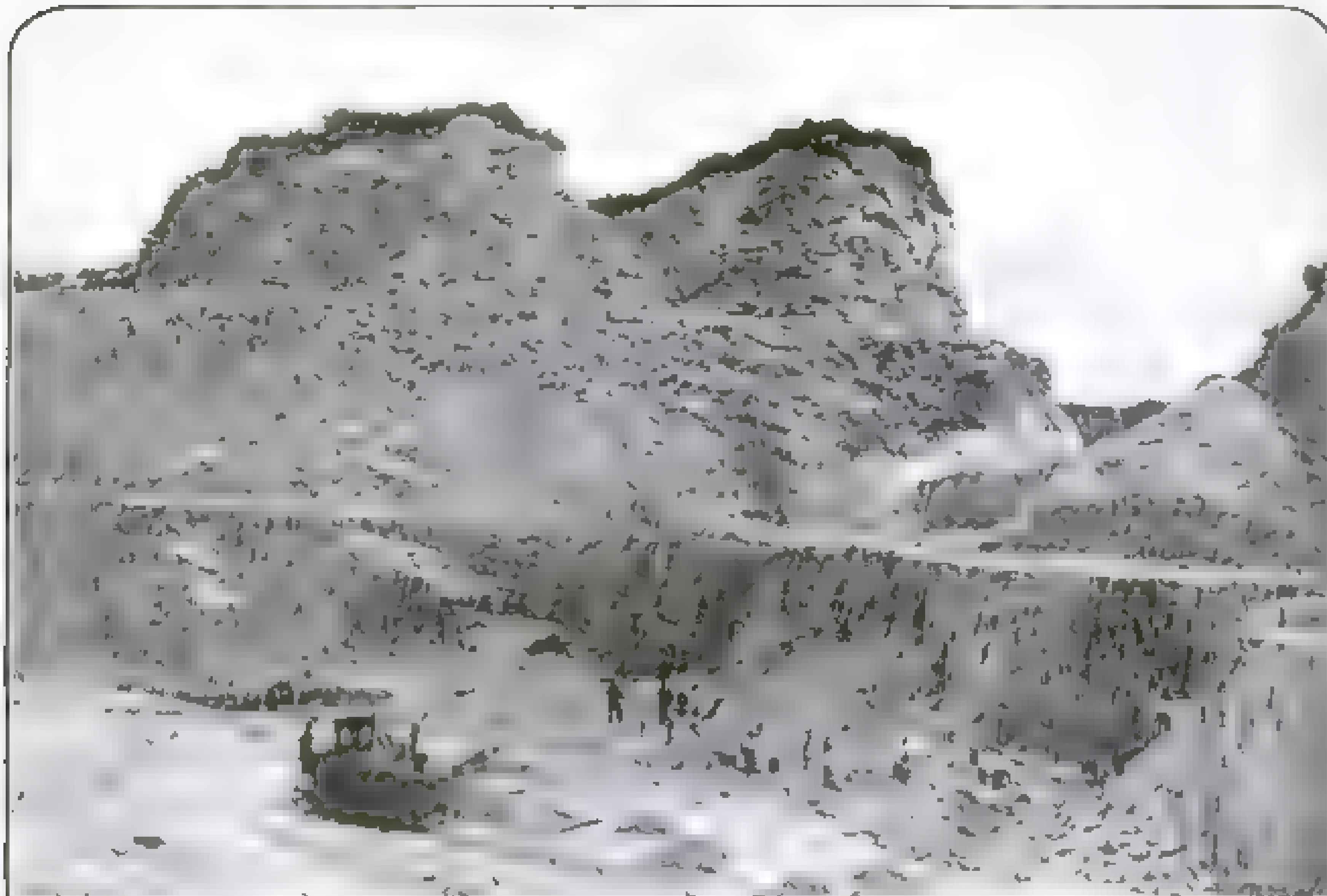
A Fish That Builds a Nest Like a Bird



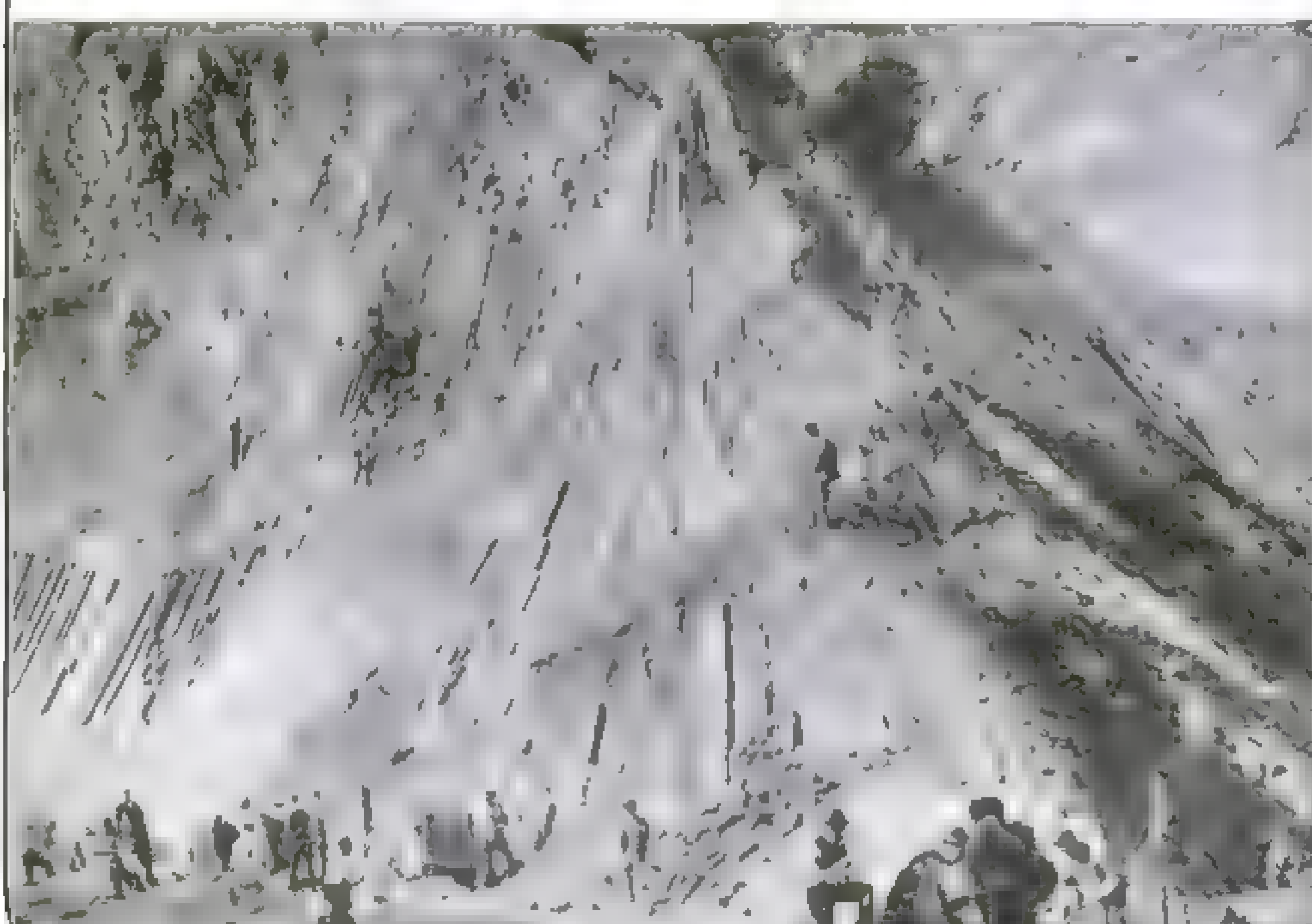
The Stickleback is one of the most interesting members of the finny tribe. It constructs a home for its prospective mate and then mounts guard over it until the mate comes along. The home is built from sea-weed, twigs and aquatic plants which are ingeniously woven together. There are two entrances to the home which are never left unguarded by the master of the house until the lady of his choice signifies her willingness to enter

In the Hoodoo Basin of Western Wyoming are curious formations which resemble Punch and Judy heads, grim savages, simpering old maids, monkeys, rabbits, birds and animals in every grotesque and exaggerated shape imaginable, and in every possible position. There are fifty different shapes of heads, over forty different animal and human faces have been counted, and inspiration for innumerable cartoonists may be found there. The rock out of which the hoodoos have been carved by Dame Nature is what is known as volcanic breccia

Where Germany Gets Her Basalt Paving Blocks



Although [illegible] German [illegible] long strips, following the natural [illegible] at the quarries [illegible] A good workman can make about six hundred blocks in a day.



Introducing Our First Anti-Aircraft Gun

Photo Central News

Mounted on a special platform forty feet high on the battleship Texas is a three-inch naval gun adjusted so that a high angle of elevation can be attained. It is said to be the forerunner of a new type of anti-aircraft gun with which those most interested in our naval and military "preparedness" will adorn the first-line battleships of the future

The Indian's Conception of Angels and Devils

Below: Two totem poles which formerly marked the headquarters of tribes in Old Mangel, Alaska. To the Indians these designated a religious as well as a clannish bond

At left: A wooden mask carved and painted in the elaborate style dear to the heart of the Iroquois Indians and used by a false-face society

A typical ceremonial mask of the Iroquois. These masks, which seem only hideous, have a tribal significance

The mask on the right would doubtless frighten away any kind of a demon. It was worn by the medicineman

On the left: Another ceremonial mask less typically Indian but evidently meant to depict his enemy-friend, the white man

The Indians were especially fond of animal masks. To them they symbolized the kinship of man to his dumb neighbors

Photos by American Museum of Natural History

Some Curious Clocks of Paris

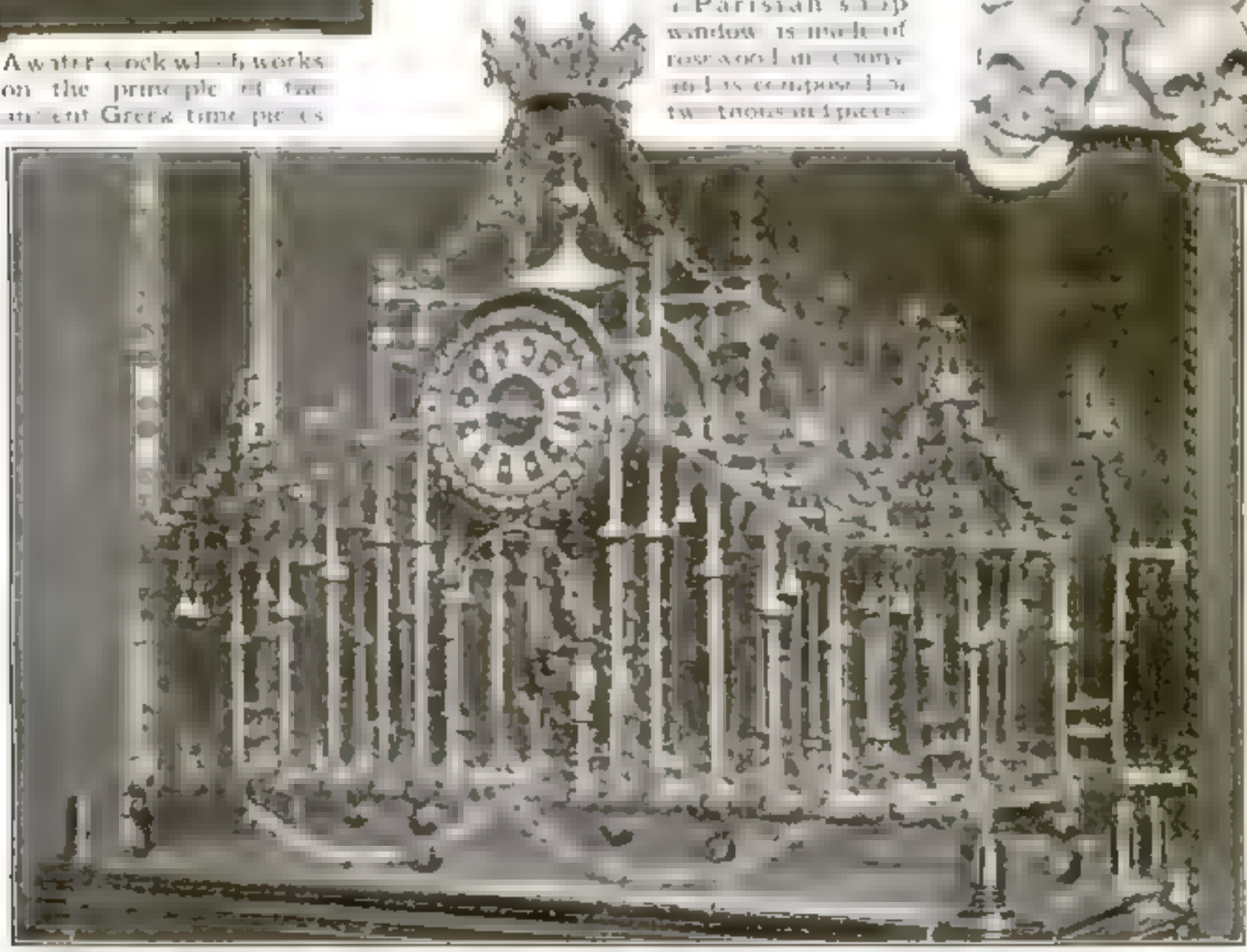
A water clock which works on the principle of the ancient Greek time pieces

Above The bowl is a soap plate the figures are oyster shells and the hands are a knife and fork

To the right The strange clock is a lead pencil mixer The hands and the numbers are tubes of large lead pencils

A clock arrested by time tells and resting on human skulls

The clock below, in a Parisian shop window is made of rosewood and ormolu and is composed of two thousand pieces



A Great Collapsible Field-Periscope

A giant German field periscope captured by the French during the earlier battles on the Somme It was constructed by Zeiss, of Jena. The illustration shows it elevated to a height of fifty feet, the carriage supporting the collapsible tube at that height without any props or other assistance However, with the aid of stays and struts, the periscope can be extended to eighty-five feet, its greatest height. The insert shows the instrument packed for transporting

Watching a Battle Through a Super-Periscope

Secreted in their headquarters in the wine cellar of a demolished chateau, the officers are able to watch the battle raging outside with the aid of an immense periscope supported in its place by a wall of masonry The roof of the cellar is covered with bomb proof pads There is nothing to betray its location to the enemy—not even the glinting of the sun on the exposed glass surface, as is so often the case where telescopes are used. The big periscope affords a wide view of the field, while at the same time the observers are safely sheltered

Supplying the Market with Ducks From

Above: A duck farm where 124,000 ducks are raised for the market each year. About seven thousand ducks are hatched each week The photograph shows the ducks drinking from a trough. Water is supplied from the pipe running above

Below: Taking the temperature of the eggs in the incubator. About 2,200 ducks are kept in the nest pens. The eggs are gathered from these pens at the rate of 1,800 a day and put in the incubator

Above: The farm upon which the ducks are raised is traversed by a creek which is divided into pens with sloping banks of sand upon which the feeding troughs are placed. The brooding season is not continuous. The incubators turn out their hatchings from early in March until early in July. Marketing of the six months old and year-old birds begins in April and lasts until about November The season for the younger ducklings is considerably shorter

The Largest Duck Farm in the World

Above A huge flock of full grown ducks reaches the market The ducks are kept until they are about eleven weeks old, when they are killed, picked and dressed for city consumers

Below Food is carried to the numerous pens in cars which run on a narrow elevated railway Twenty tons of feed are shoveled out in a day The food consists of corn oats and other grain and green food

Let a Blast of Air Do It

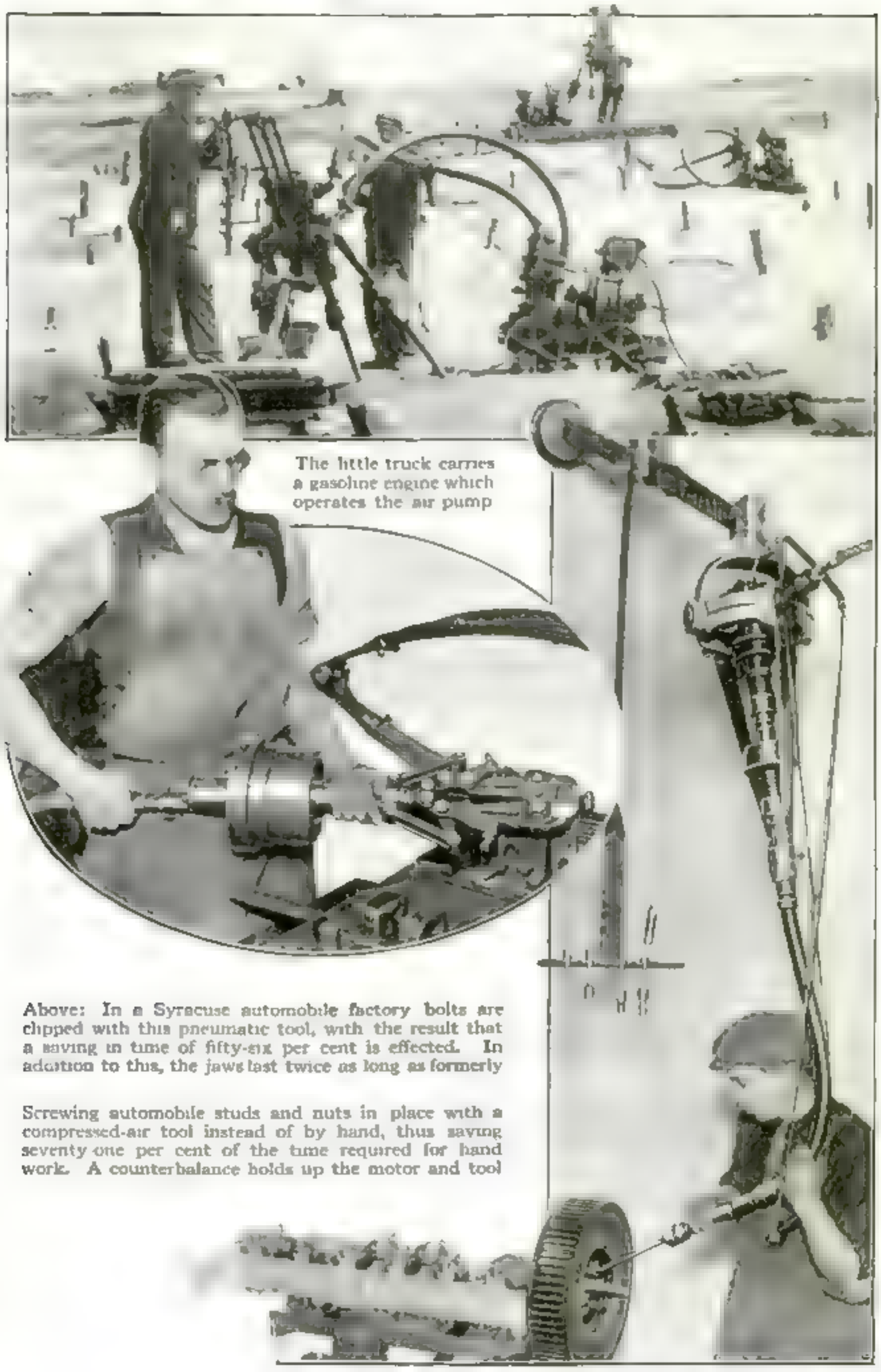
Driving home the spring clip nuts on an automobile front axle by compressed air. This air-driven wrench saves fifty-six per cent of the time required in using the hand wrench

In this operation a saving of seventy-five per cent in time is effected as compared with the hand operated drill

At left: A hand hammer drill for use in restricted quarters. It weighs about fifty pounds and requires no mounting or extra help

Below: A rock drill, gasoline-operated. The air is not permitted to escape but is used over and over again

Air Is Stronger Than Human Arms



The little truck carries a gasoline engine which operates the air pump

Above: In a Syracuse automobile factory bolts are chipped with this pneumatic tool, with the result that a saving in time of fifty-six per cent is effected. In addition to this, the jaws last twice as long as formerly

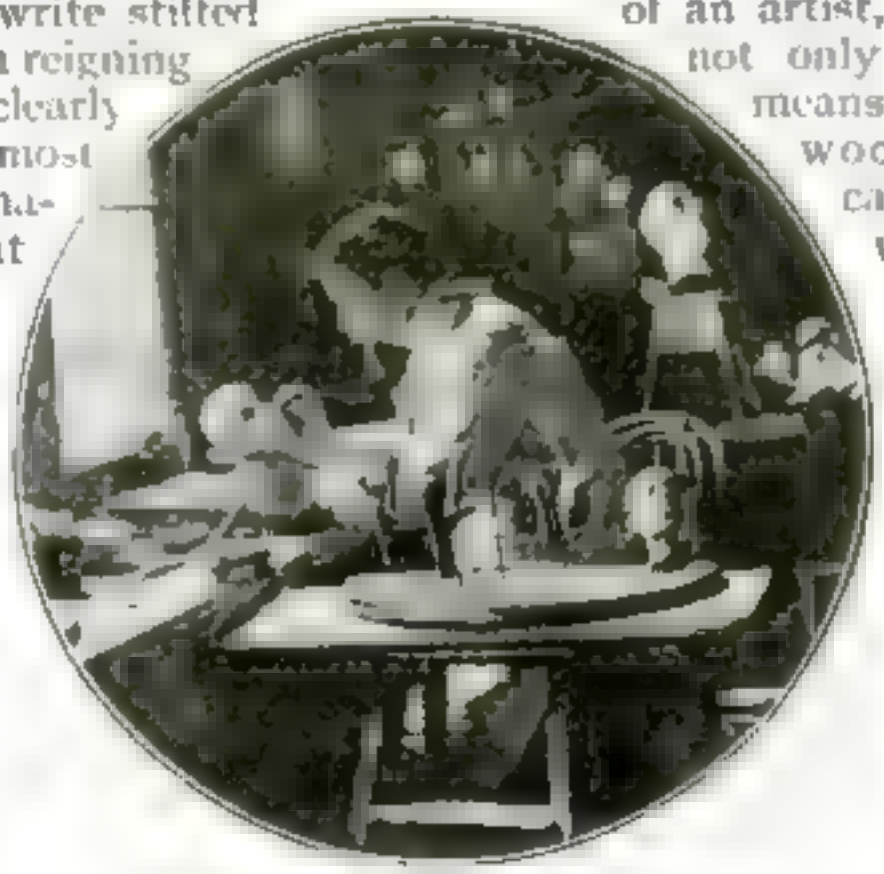
Screwing automobile studs and nuts in place with a compressed-air tool instead of by hand, thus saving seventy-one per cent of the time required for hand work. A counterbalance holds up the motor and tool

Dummies That Dance and Play

Wonderful mechanical musicians that smoke, bow, wink and pirouette

TWO hundred years ago, before the days of the steam engine and of the factory, the inventive ingenuity of a mechanic, who was bubbling over with ideas, expressed itself in the making of huge automatons—artificial human beings crammed with clockwork and capable of executing with astonishing fidelity acts which seemed to require the control of a brain. There were automatons that danced minuets, automatons that could write stilted phrases in praise of a reigning monarch far more clearly and correctly than most courtiers, and automatons that even went through the motions of playing a game of chess. They were mechanical curiosities—nothing more.

But it must not be supposed that the art of making mechanical dummies is dead. Indeed, it flourishes more richly than ever, simply because it has been put upon a commercial basis. Only once in his lifetime would an eighteenth century mechanic produce a dancing or letter-writing figure; it was years before he completed his labors. But with the aid of modern factory machinery, automatons are turned out as easily and as rapidly as automobiles. Who wants them? The Coney Islands and the Earl Courts of the world. Somehow the huge, automatic musical orchestras, to the accompaniment of which one eats popcorn and marvels at the tattooed man, are far too tame for the sensation-loving showmen who enliven popular seaside resorts. The orchestrions lack the human touch. And so, the machinery that grinds out the latest dance or the latest song must be adorned with mechanical figures—figures clothed with garish care and very lifelike in their stiff, mechanical way. They beat drums, dance, and juggle; indeed they behave very intelligently and correctly.



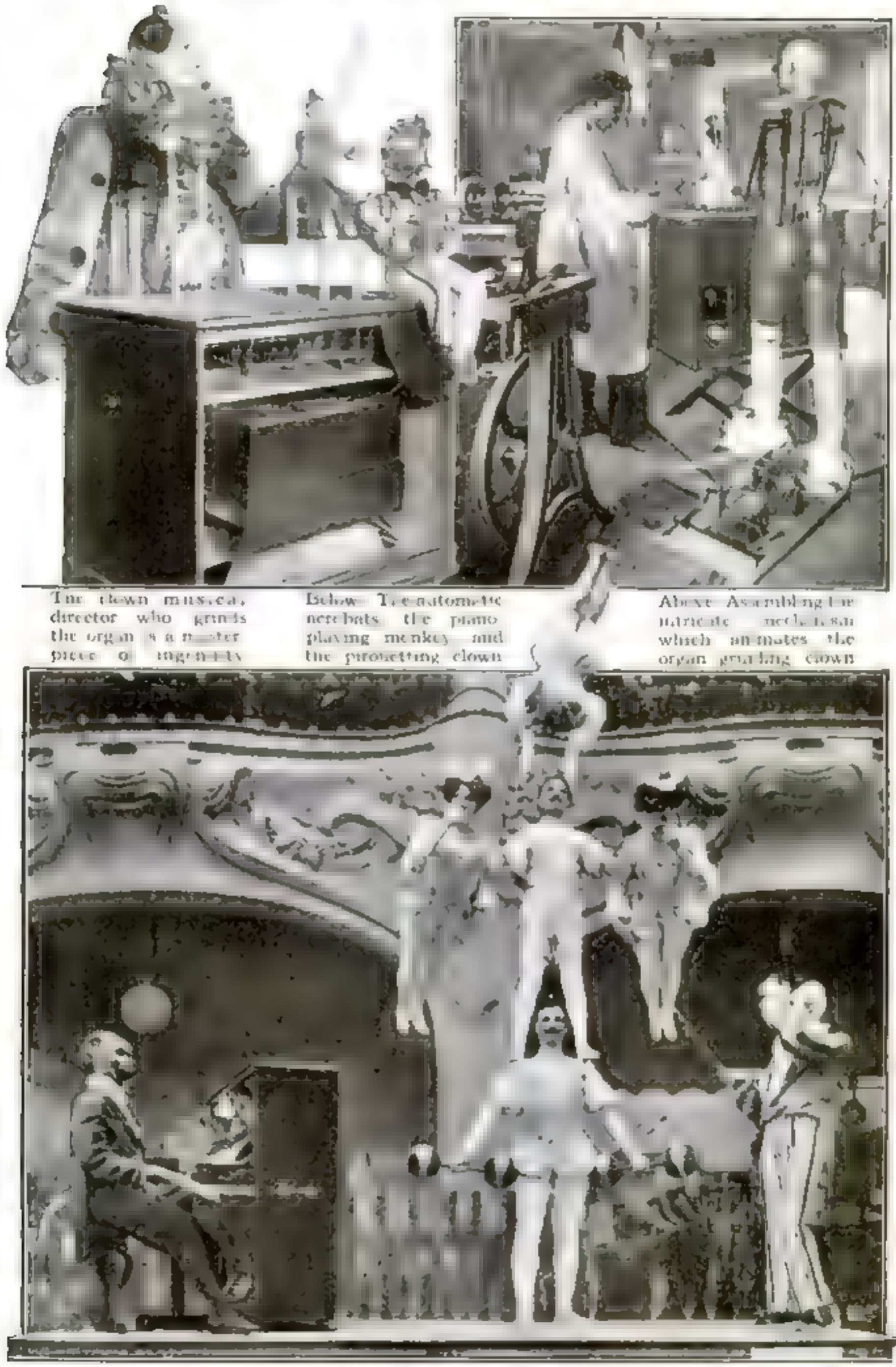
Painting the faces of the mechanical musicians in Triboulet's shop

Triboulet of Paris, is the man who invents many of the more ingenious dummies. That he is exceptionally ingenious follows from the very nature of his creations. He must be something of an artist, too; for he devises not only the machinery by means of which figures of wood and metal cut capers, but creates a whole setting like any stage manager.

First of all, a scene is planned. Then a model of that scene with all the figures in it is made in plaster or in wax, and a cast taken. If this piece of sculpture turns out satisfactorily, working drawings are made of heads, arms, legs and the like for the guidance of shop mechanics.

The animating mechanism of these huge dolls is complicated enough, as our illustrations prove. The clown who grinds the organ, the pyramid of tumblers, the monkey who plays the piano with astonishing skill, are all operated by spring motors and are wound up like any clock. The machinery within the dummies is operatively connected with the music-producing mechanism. By means of starwheels (little copper plates, regular or irregular in form) levers are thrown which operate subsidiary mechanism for the purpose of making a dummy smoke a pipe, whistle, wink mischievously, bow, and perform a dozen ordinary actions.

Acrobatic and Dancing Dummies



The clown musical director who grinds the organ is a master piece of ingenuity

Below: The automatic acrobats, the piano playing monkey and the prancing clown

Above: Assembling the intricate mechanism which animates the organ grinding clown

A map of West Virginia made on muslin sheeting. The cities and large towns are designated by tiny electric lights

Making a Huge Electrical Map of West Virginia

AT a recent gathering of telephone men in Wheeling, West Virginia, a map of the state, ten feet by twelve feet, was made at short notice by A. J. Schulz, of Baltimore. It was hung in the banquet hall and as telephone connection was made with a particular city a little electric light representing that city would appear at the proper place on the map. It was a practical demonstration of how the telephone lines bind together the parts of the state, regardless of mountains, rivers and other barriers.

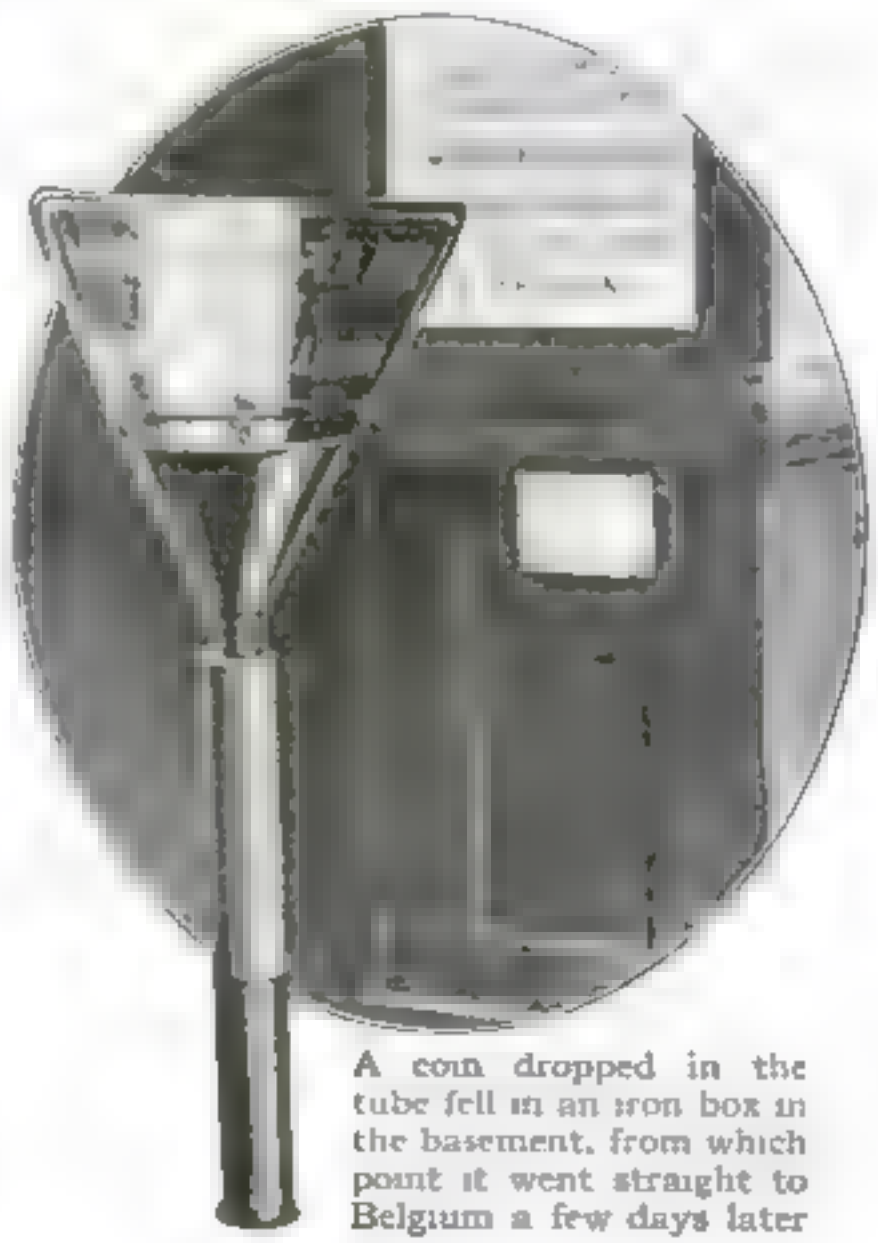
In its completed form the map was seven times larger than the one from which it was made. Tiny electric lights represented the cities and large towns. A switch was installed behind the map and an operator flashed in the different cities as they were called.

Collecting Money for Belgians by a Sidewalk Chute

IN order to increase the Belgian Relief Fund, the Boston Headquarters have invented a novel scheme to secure money from the busy throng which pass the headquarters day and night.

A steel tube four inches in diameter with a funnel-shaped top has been inserted in the sidewalk in front of the building. It is painted with the colors of Belgium, black, yellow and red, and over it is the inscription: "Money Dropped Here Goes Direct to Belgium."

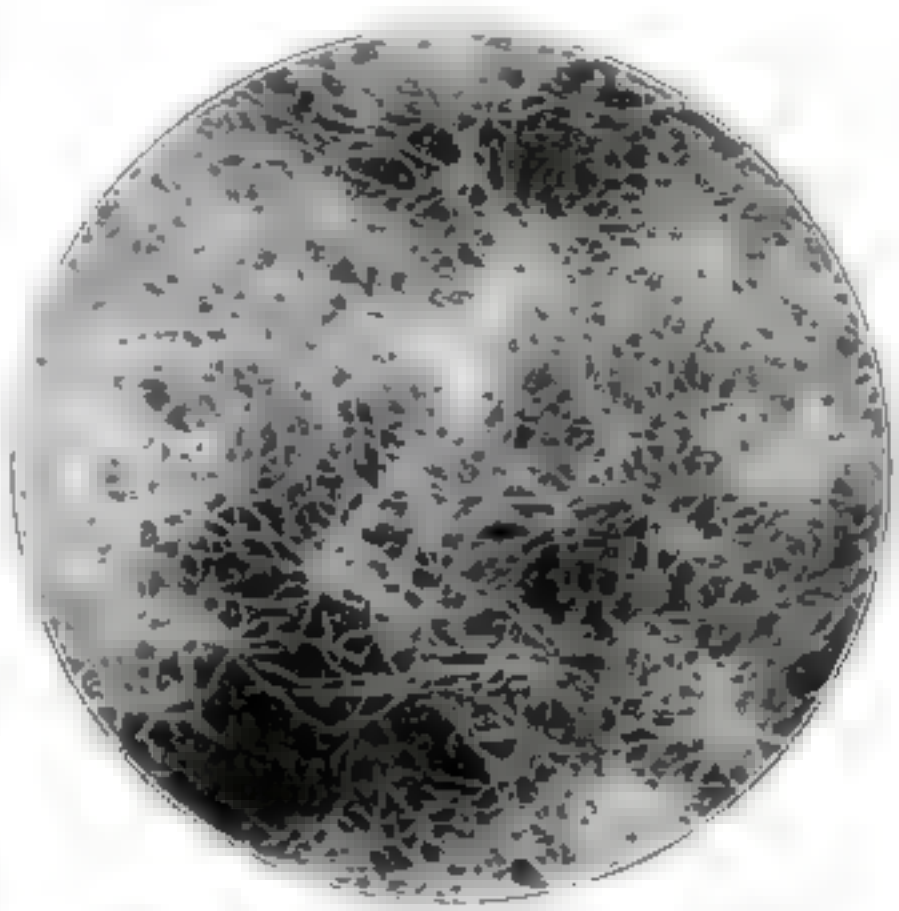
The chute runs directly into the basement and into an iron box from which the money is collected and then forwarded abroad.



A coin dropped in the tube fell in an iron box in the basement, from which point it went straight to Belgium a few days later

Just How You Wear Out Your Clothes

WE speak, and speak correctly, of "wearing a suit of clothes" when we have in mind only the use of the clothes; but the garments are literally worn away. We might also speak of "wearing" bed-clothes, because the fibers of the bed linen are worn away in much the same manner as a carpenter wears away the surface of wood when he sandpapers it. Draughts and other air currents waft these fibers to and fro until they collect in small clusters of "fluff." The "buts and cantles" that have begun to attract others to them gather more and more, until a large proportion of the aerial flotsam has been transformed into what the housekeeper calls "little rolls of dust" that she finds under the bed and in the corners. These are fibers that friction has removed from the bed linen and from one's clothing.



Small clusters of "fluff" blown into what the housekeeper calls rolls of dust

Whenever cloth is handled, some fibers are rubbed off and in time become visible and objectionable. The formation of this fluff is not unlike the growth of snowballs that boys roll.

Under the microscope, especially with reflected light, these balls of fluff are wonderfully beautiful, gleaming with a brilliancy that cannot be captured by a photograph.

A New Check Protector No Bigger Than a Pocket Match-Safe

A NEW check protector has just been invented by an Oakland, California, man. It is so small and compact that it resembles a pocket cigar-lighter and can be carried in a vest pocket as easily as a match-safe.

It consists of a metal holder, at one end of which is inserted a round steel die, containing hatched lines. This steel die revolves and its surface comes in contact with an ink pad placed inside the holder. The check to be protected is placed upon a small corrugated aluminum board, furnished for the purpose, and then the hatched wheel of the protector is brought into position on the surface of the check, over the written amount. With a slight pressure the wheel is slowly revolved across the face of the check.

The revolving wheel both prints and perforates the paper, following the grooves of the aluminum sheet underneath. The result is a series of printed, and perforated hatched lines, in a faint-colored ink, which does not interfere with the legibility of the writing but does prevent any erasures or changes.

The chief advantage of the new protector is its size.

A small, compact instrument for preventing the erasure of signatures on checks

"Is it not fair to assume, nay, is it not certain, that if battleship displacement has increased from ten thousand tons in 1896 to thirty-two thousand tons in 1916, that it will continue to do so until the limit has been reached? Why not go the limit at once? By so doing we scrap the battleships of every navy in the world. . . ."

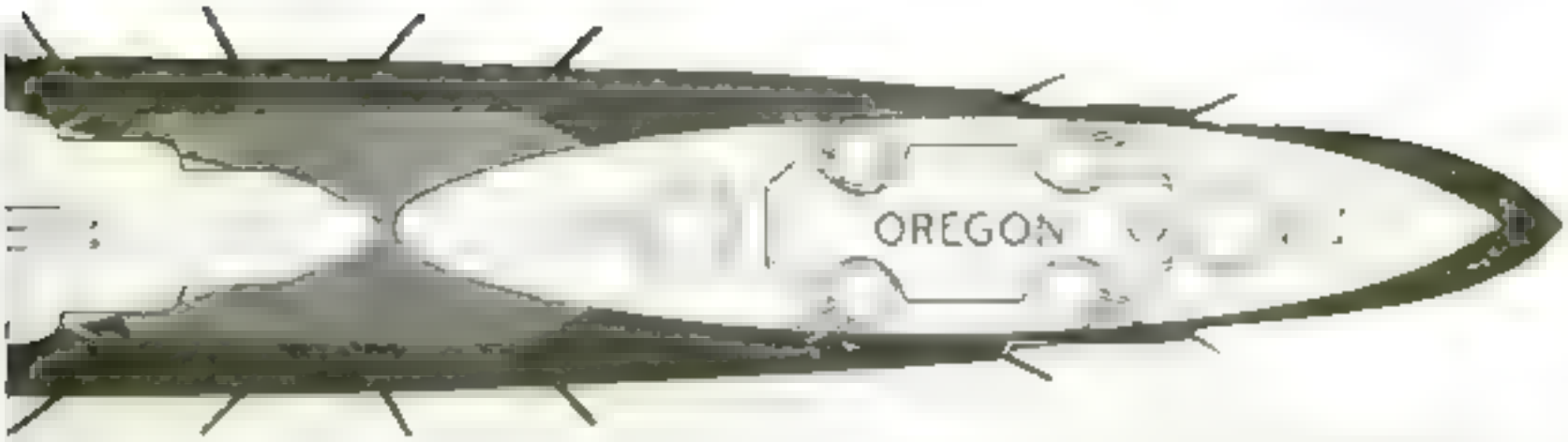
Moffett's ship, shown behind the Pennsylvania and Oregon, is about as long as both vessels.

The Thousand-Foot Battleship

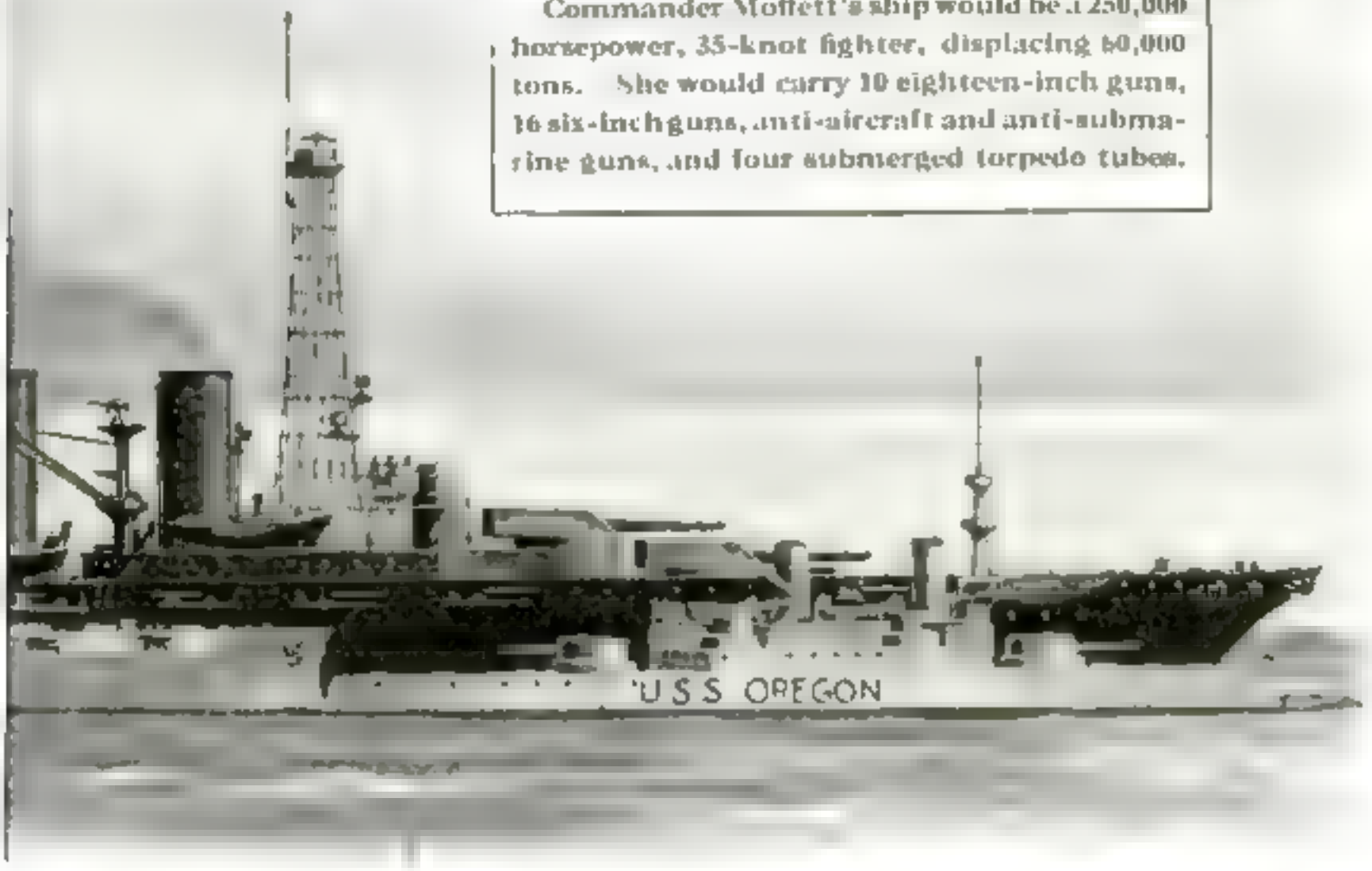
Commander Moffett's daring plan to beat the world

HITTING a target at ten miles with fifteen-inch guns seems so easy a task in view of the naval battles fought off the Dogger Bank and Jutland that Admiral Sir Cyprian Bridge of the British Navy, maintains that it is inadvisable to build warships bigger than those now in commission. Commander William Adger Moffett of our own Navy, takes direct issue with him, arguing that the whole tendency in warship construction from the days of the sailing frigate to the modern super-dreadnought has been toward the large ship with large guns. He boldly advocates a vessel more than twice as large as any battleship hitherto constructed—a veritable Titan of the seas.

In an article published in "Sea Power," Commander Moffett points out that only the size of the locks of the Panama Canal limits the size of battleships. That limit applies to the warships of the entire world as well; for no power would sacrifice the advantage of being able to send its fleet through the Canal. Since the Panama Canal locks will receive vessels of one thousand feet length and



Commander Moffett's ship would be a 250,000 horsepower, 35-knot fighter, displacing 60,000 tons. She would carry 10 eighteen-inch guns, 16 six-inch guns, anti-aircraft and anti-submarine guns, and four submerged torpedo tubes.



She could carry the Pennsylvania and Oregon on her decks, as illustrated in the top plans

one hundred and ten feet beam, the maximum length and beam of the future warship are fixed. "Go the limit at once," urges Commander Moffett, "while we have the opportunity to do it, ahead of all our rivals, and go the limit at the same time in everything; that is to say, in speed, caliber of guns, endurance, fuel, ammunition, etc."

Puts Limit at 60,000 *Tons*

Commander Moffett points out that the growth of the United States battleship from the Oregon type to the new Pennsylvania has been accomplished in less than twenty years, and submits in addition the specifications of his proposed sea giant, the Limit, in the following comparative table.

Battleship	Date	Length	Arm'm't.	Ton'ge
Oregon	1896	358 ft	4 13-in	10,288
So. Carolina . . .	1909	450 ft.	8 12-in.	16,000
Delaware	1910	510 ft.	10 12-in.	20,000
Pennsylvania	1915	600 ft.	12 14-in.	31,400
Limit.	1917	995 ft.	15 18-in.	60,000

To quote Commander Moffett:

"Other navies would have to follow our example, and build ships like ours or give up the competition. We could stand the cost better than any other nation. It is, therefore, an advantage to us to make navies cost as much as possible. We have more money than any other nation and will have more, comparatively, at the close of the war, when most of them will be bankrupt.

"In this way we will scrap England's navy, as well as all others. In no other way can we hope to overtake Great Britain.

"Build the limit in displacement, in speed in caliber of guns, with proper proportion of fuel and ammunition, endurance, etc., and we will have, indeed, the first real superdreadnought."

Strenuous Search for Durable Roads in a St. Louis Park

TO the average motorist there are only two kinds of roads, good roads and bad roads. To the road engineer, roads are divisible according

From the dial which the engineer is examining the durability of the roadway is determined

to materials, such as asphalt, brick, etc.

An interesting case came to light recently when the road engineers of St. Louis began discussing stresses, temperature coefficients and other highly technical things in connection with the roadbed of a St. Louis Park. Then an effort was made to find a pavement which would maintain its smoothness regardless of weight and speed of vehicles. The roadway was divided into small sections and concrete applied in various mixtures. Then the roadbed was tried out. The motorist looked upon it as an excellent stretch for a spurt; the engineer looked upon it with an instrument almost as delicate as a microscope.

In the photograph the gage used by the engineers is shown with a solid bar of steel laid parallel to it for purposes of accuracy in measurement.

Charging the Weak Magnetos of Automobiles

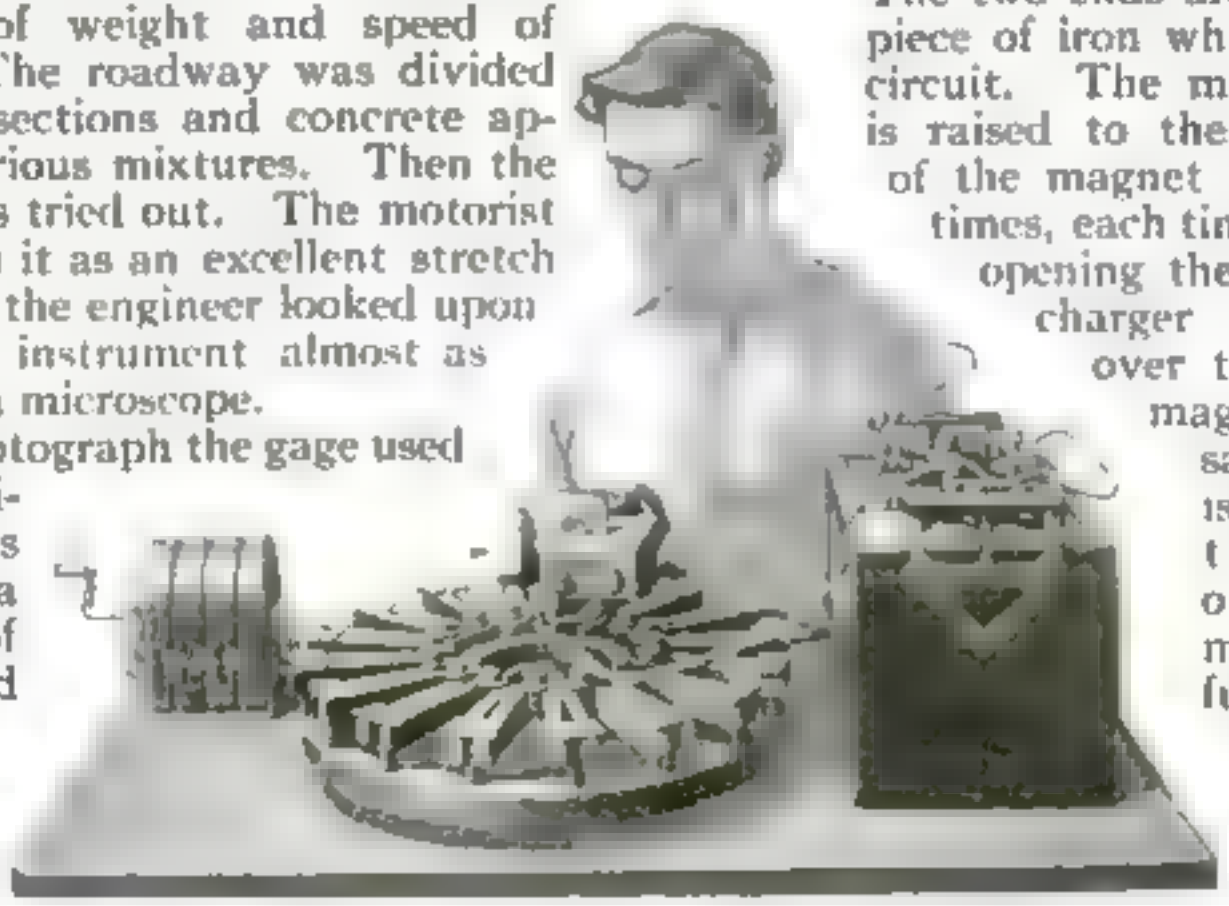
THE magneto on your Ford can be effectively rejuvenated by means of a magnet-charger specially designed for use where a 110-volt direct current line is not available. When your car fails to start easily and you have to change from high to low speed frequently, you may be sure the magneto has become weak.

When someone tells you that he cannot hear your voice in the telephone, it is because the receiver magnet is weak. Party lines are especially liable to suffer from weak generator magnets.

The magnet-charger can be operated from an ordinary six-volt storage-battery, or from a storage-battery charging outfit, such as that used in garages to charge starting or lighting batteries. Three or four applications of the current on each end of the magnet up to its maximum strength may be made.

The charger is in the form of a small box having a handle and also a hole in which one end of the magnet is placed. The two ends are placed on a piece of iron which closes the circuit. The magnet-charger is raised to the curved part of the magnet three or four times, each time closing and opening the switch. The charger is then held over the top of the magnet, and the same operation is repeated with the switch open. The magnet is now fully charged.

The simplicity of the operation is its chief recommendation.



Rejuvenating your Ford magneto is the work of five minutes with this new specially designed charger

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Maybe you have special needs. Write to the editor about anything within the scope of the magazine. He will be glad to help you.

Lifting Street Cars with a Powerful Electric Hoist

THE lifting of street and interurban cars without the use of a hoist or crane is tedious and expensive. A dozen men or more are required, and the task consumes much time. The hoist shown in the accompanying illustration does its work with practically no human aid and cars are lifted and removed from railroad flat-cars in five minutes.

The hoist can be used for loading as well as for unloading cars, the operation being about the same. Four long lifting-chains, after passing over the chain-sheaves, are wound on right and left hand-drums situated at the top and center of the hoist. The shaft on which both drums are mounted carries an ordinary railway gear. Lifting power is supplied by a motor.

It takes but five minutes to remove a car with the hoist. The railroad flat-car on which the street car is loaded is run under the hoist. After the chains have been secured to blocks, which have been put under the car to be lifted, the car is hoisted high enough so that the flat-car can be pulled out from beneath it. The street car is then lowered to the rails.

The electric hoist does not confine its usefulness to the lifting of street cars alone. It has been used successfully in unloading heavy motor-trucks from railroad flat-cars and for temporarily suspending automobiles and other vehicles.

Its advantage is that it obviates the use of a pit.

With practically no human aid the electric hoist lifts and removes street cars from railroad flat-cars in five minutes

Getting Drunk with a Pair of Ordinary Opera Glasses

THE same sensations, minus the alcohol, experienced by an intoxicated person who is trying to walk in a straight line or on a narrow sidewalk which is only thirty feet wide, can be had by anyone who takes the trouble to draw a straight line on the floor and then look at the line through a pair of opera glasses in a reversed position.

After the glasses are focused try to walk on the line. You will find it impossible to follow it closely. The line will look like an ink scratch on a surface miles away and the closer you look and try to follow the line the more vexed your vision becomes and as a result your feet wander from side to side, getting farther away from the line all the time.

Even with the naked eye it is difficult to "walk the chalk" for any distance without growing dizzy and staggering suspiciously.

Reverse the opera glasses and walk on the line if you can

There are no exposed levers or flywheels and the motor is enclosed in a casing

A Tiny Portable Hoisting Engine of Dual Power

A DIMINUTIVE but powerful hoisting engine that handles loads of one thousand pounds or less over distances of several hundred feet has been designed recently. It is operated either by steam or by compressed air.

This little hoist, said to be the smallest practical one of its kind, has the additional feature of safety, having no exposed levers or flywheels. It is designed for rough service, particularly for use in mines and quarries. It is portable, and can be mounted almost anywhere—clamped to a pipe or column or bolted to the wall.

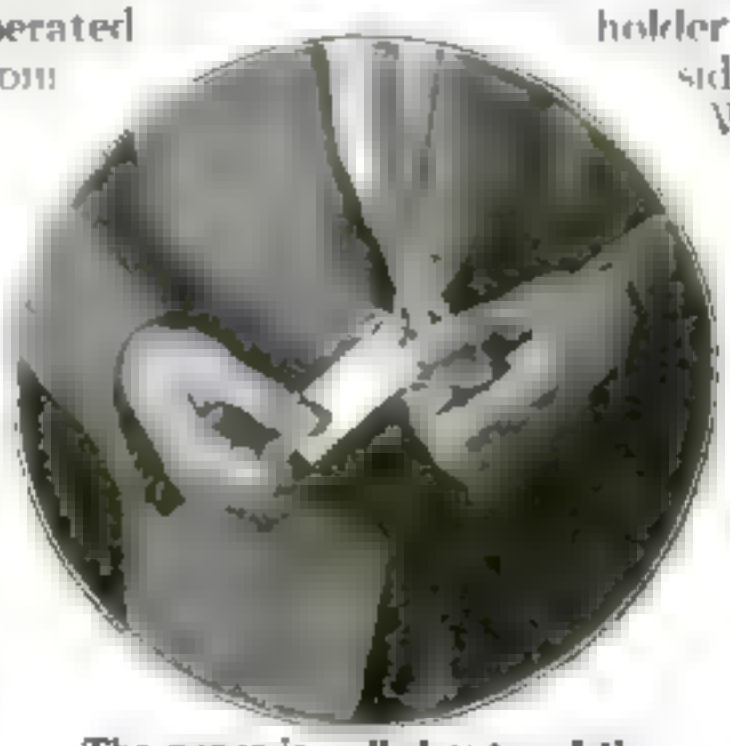
Both for safety and durability, the motor is contained in a casing. The brake is a band-type operated by a worm—a screw with a long pitch—to constrict it, so as to give greater holding power.

Why the Rain Follows the Thunder and Lightning

WHY does a heavy downpour of rain often follow a clap of thunder? Not, as is popularly believed, because the thunder jostles the cloud particles together into raindrops. In the violent turmoil between the positive and negative electricity in a thundercloud there will be places where the production of drops, by condensation, and their subsequent breaking up proceeds more rapidly than elsewhere. Hence in these places there will be more drops to fall as rain, and also more electrification, the rainfall occurring about the same time as the flash. We have, then, starting toward the earth at the same time, light, sound, and raindrops. The light, traveling at a speed of about 186,000 miles per second, reaches us almost instantly. The sound travels far more slowly—about 1,090 feet per second—but the rain falls much slower still. Thus we observe, first, the lightning, then the thunder, and then rain.

A Tobacco-Can with a Roll of Cigarette Papers Attached to It

FOR the convenience of smokers who prefer to roll their own cigarettes, Bertram A. Rose, of Fort Worth, Texas, has invented a cigarette-paper holder attached to the under side of a tobacco-can cover. When he wants to roll a cigarette the smoker pulls the paper outward and downward from its position on the roller, and then tears it off for a long or short smoke by using the outer edge of the lid as a cutter.



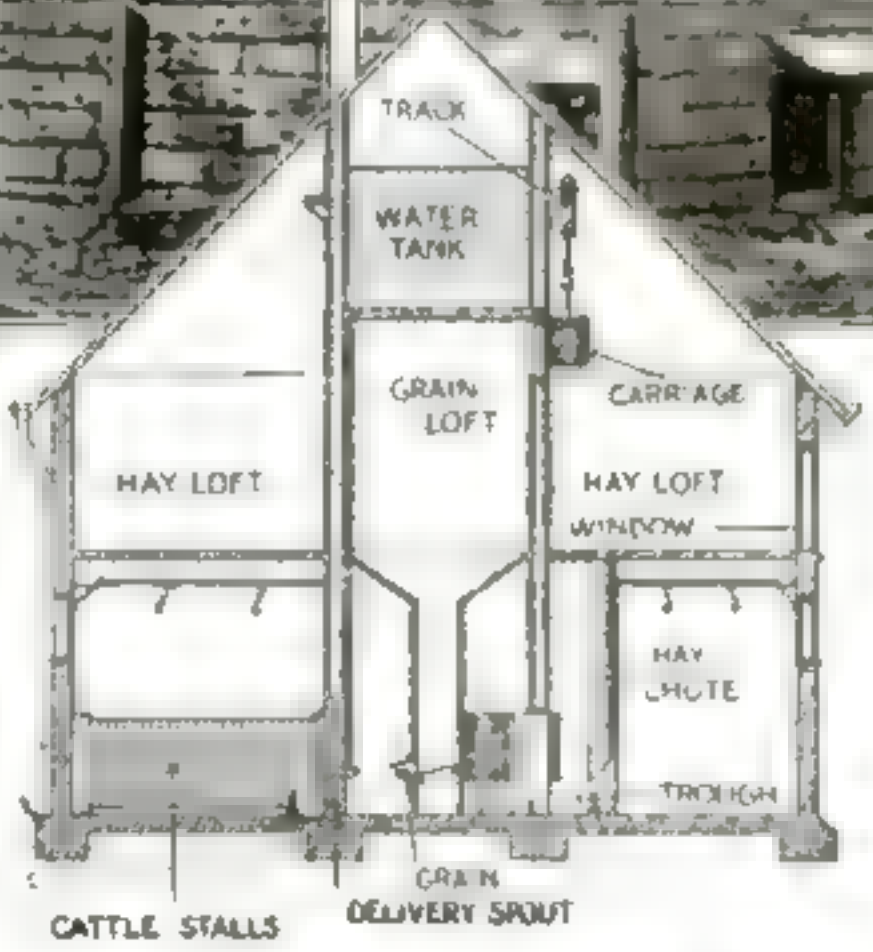
The paper is pulled out and the edge of the box-cover cuts it

In pulling the paper outward and downward over the edge of the lid the "roll" is taken out. The paper may be perforated to facilitate the tearing and cutting operation, but the inventor relies mainly upon the outer edge of the lid for cutting each piece of paper as it is pulled from the roll and pressed against the tin.

The Handiest Barn Ever Built

Hay, grain and water are all stored in the center

The barn consists of two cylindrical cement walls, one within the other



The building is forty feet wide, with a sixteen foot feed-room

A BARN, built like a fort, with the feeding-hoppers and watering-troughs grouped together around the center of the building, has been patented by Peter O. Swedberg, of Marshalltown, Iowa. The barn is constructed of cement blocks. It consists in the main of two cylindrical walls, one within the other.

Within the inner or central barn chamber are kept the troughs and feed-hoppers, together with chutes leading to them from chambers in the upper part of the barn.

No time is wasted in traveling from one end of the barn to the other to feed the cattle: for hay, grain and water are all at hand in the central portion of the barn. Here also are located the troughs and hoppers in front of the stanchions radiating from the central chamber.

The building measures forty feet in diameter with a sixteen-foot feed-room in the center. The outside wall is eleven feet high. The wall of the inside chamber or feed-room is twenty feet high. A five-foot water tank is provided at the top.

One of the principal time and labor-saving features is an elevated track or runway which extends around the interior of the barn. On the track is mounted a carriage which supports a receptacle for transporting material from one side of the building to the other.

Provision has been made for heating the interior by a stove. A pipe runs from the left of the center space up through the conical roof. Near the stove is a spout from which fine food or grain is supplied. When hot water is needed for mash it is readily available.

A Modern "Newspaper Maker"

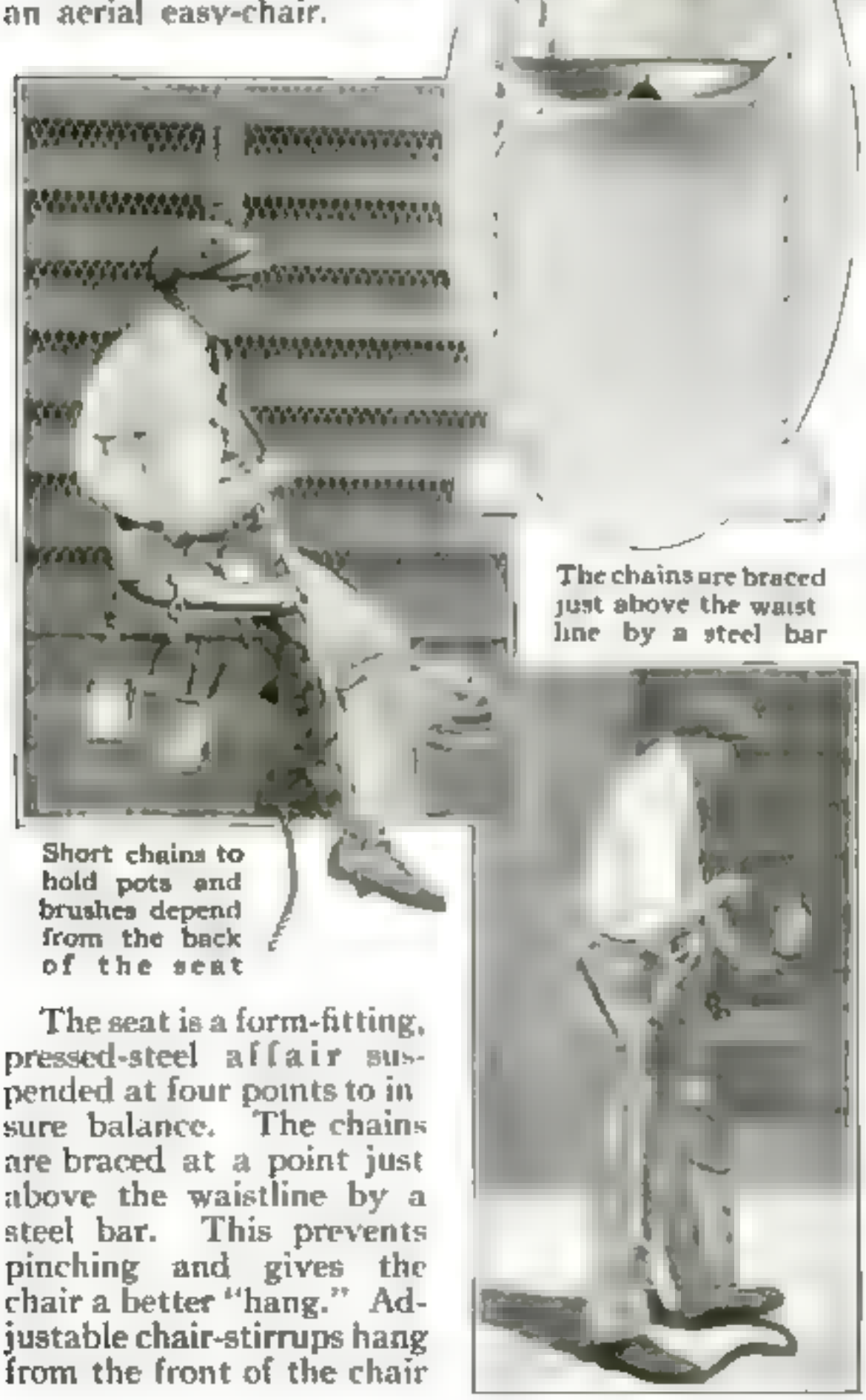
Over two hundred inventions are incorporated in the mechanism of the machine. The coördination of the various parts of the folder was obtained by distributing air pressures and vacuums so that the paper is carried, not pulled, along

THE speediest printing press in the world, having an hourly capacity of 65,000 newspapers, has been completed for the New York Herald. Henry Wise Wood is the designer and constructor. The new press embodies a vast number of improvements, so that in spite of its tremendous speed the attention it requires is even less than that of the ordinary newspaper press. It delivers papers folded into either 8, 16, or 32 pages. Great difficulties were overcome before the folder was perfected. Principles of aeronautics were applied.

Sitting Down in Comfort on a Painter's Job

THE simple skill of the sailor evolved a seat in which he could paint the sides of his ship or repair his topmost rigging. It was merely a notched board set into a looped rope-end—a child's swing, except that it depended from one line instead of two. It was an uncomfortable, one-handed affair at best; yet it was, and is still, used by steeple-jacks, painters and such like, with small variation. The inventive mind had passed it by until recently, when an employee of a New York electric company transformed the old swing into an aerial easy-chair.

Adjustable stirrups hang from the front of the chair and enable the painter to stand up when he wishes



The chains are braced just above the waist line by a steel bar

Short chains to hold pots and brushes depend from the back of the seat

The seat is a form-fitting, pressed-steel affair suspended at four points to insure balance. The chains are braced at a point just above the waistline by a steel bar. This prevents pinching and gives the chair a better "hang." Adjustable chair-stirrups hang from the front of the chair and prevent the cramping strain of the weight of the legs and feet upon the under-thigh muscles. They also add tremendously to the flexibility of action. With these stirrups it is possible to straighten the body into a standing posture and to maintain balance. A belt fastens around the waist through the triangular links at the brace-bar and allows two-handed action under the most trying conditions.

This belt makes accidental falling out of the chair an utter impossibility. The suspension-ring is equipped with a hook designed to simplify the hitching of the hauling-rope, and holds the hitch securely. Short chains depend from the back of the seat, on which pots, brushes or tool-kits may be hooked. These chains are equipped with "sister" or trap-hooks to secure the articles carried.

The painter simply adjusts the seat, buckles the strap and pulls himself up to the desired height

Is Jupiter Launching a Moon?

The mysterious Great Red Spot on the biggest of planets and what it means to astronomers

IF JUPITER were cut up into one thousand three hundred pieces, each would be larger than the Earth. All the planets together do not weigh half as much as Jupiter. Only the Sun surpasses Jupiter in size.

A year on the planet Jupiter is equal to twelve of our years. Jupiter rotates on his axis in less than half the time of the Earth. But because of the planet's enormous size, the rotation speed is much higher. While the Earth travels 17 miles a minute, Jupiter travels 466 miles a minute. If Jupiter turned on its axis a little faster, it would burst as some flywheels do, when they exceed a safe speed.

Jupiter may be regarded either as a decaying sun or a developing earth. He has not yet had time to cool. He is a great globe of gaseous and molten matter—the most extraordinary planet in the entire solar system

Because Jupiter is a semi-sun, there is some reason to believe that he possesses inherent light of his own. But astronomers are by no means in accord on this point. Perhaps the clouds, that certainly exist on Jupiter, owe their origin to some other heat than that of the Sun. In other words, Jupiter possesses stores of heat within himself.

Look at Jupiter through a fairly powerful telescope and you will see two broad belts with two or three narrower ones on either side. They lie practically parallel to the planet's equator. Sometimes they are narrow, and when they are very narrow, there is an increase in their number.

Since Jupiter is in a more or less fluid condition, he is surrounded by a dense, cloudy envelope. In all likelihood, the belts are simply rifts in this envelope, exposing the more solid portion of the planet beneath. Not much is known about the belts. While they remain unchanged for months, the fact that they do alter their appearance has led to the assumption that great atmospheric storms take place on Jupiter.

Occasionally Jupiter's belts appear spotted. Just what these spots are, no one knows definitely

It was in 1878 that the great, mysterious Red Spot of Jupiter, which has puzzled astronomers for many years, was first observed at Brussels by M. Niesten. It was 30,000 miles long one way and over 8,000 miles another. The Earth might figuratively have been dropped into the Red Spot without touching the sides.

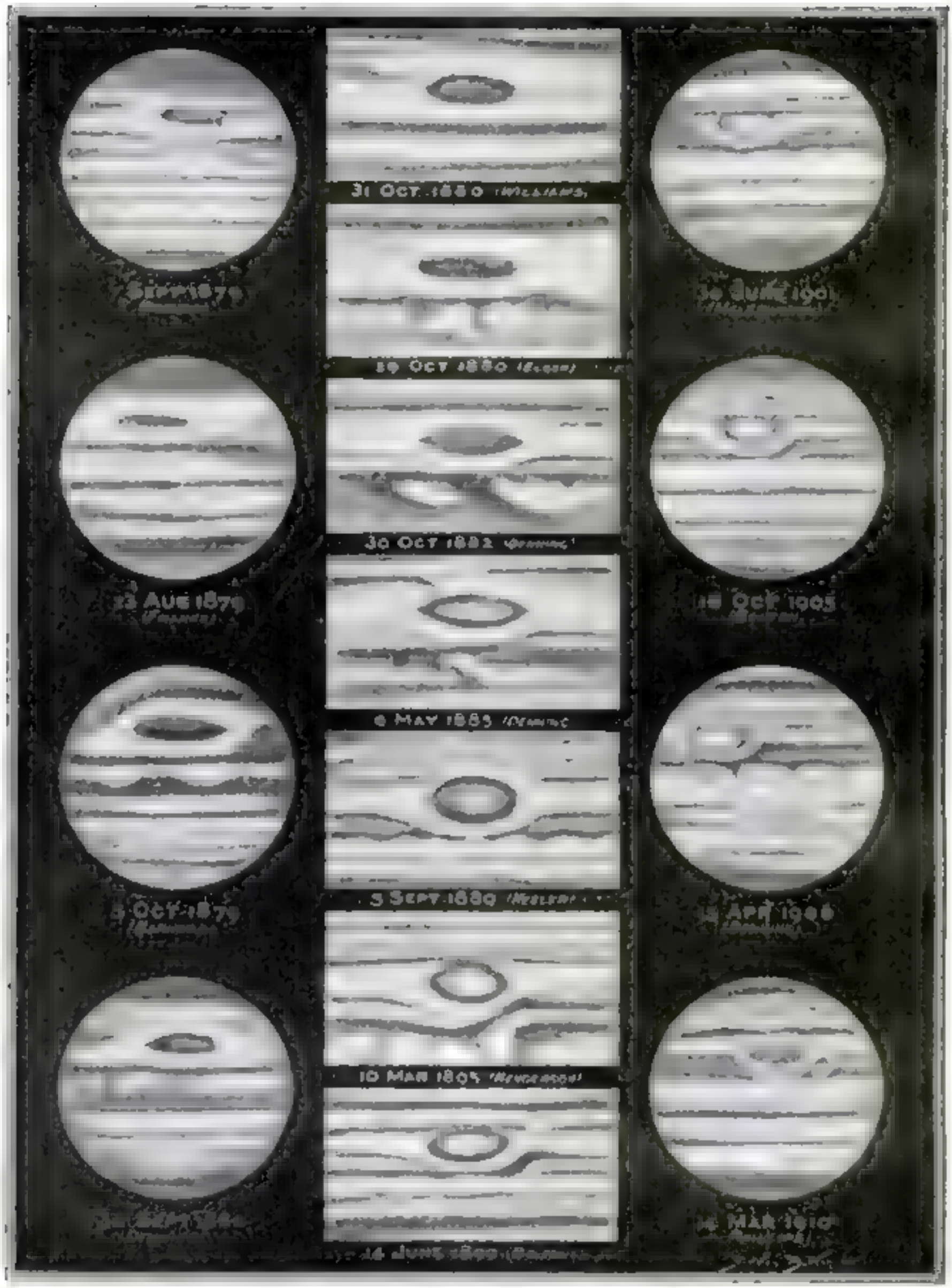
For three years, the Great Red Spot was a constant object of study. It completed its circuit about Jupiter in nine hours, fifty-five minutes and thirty-six seconds

What is the Great Red Spot? A volcano, said some. That is impossible, because it floats freely. It has a strange effect on its surroundings; it has the property of excavating them, as it were. There is a deep bay in which the spot, rather dim now, is located.

In describing the drawing appearing on the opposite page, Mr. Scriven Bolton, the English astronomer who made it says:

> "It is propounded that our earth, when once in a plastic condition, rotated on its axis so swiftly that the matter at the equator could not adhere together, and a breach caused a portion to be fractured, which portion gradually separated from the parent planet. So, apparently, in the case of our cousin planet Jupiter, whose rotational velocity at its surface is as great as ours used to be, there is at present a phenomenon which suggests an epoch in the evolution of moon-making. That puzzling object on the surface, known as the Great Red Spot, is not a fixture of the surface, or we might regard it purely as a volcanic vent emitting hot vapors. Its constituent properties have never been ascertained. . . . It moves round with the planet's axial rotation. This is especially noteworthy from the fact that theory tells us that our moon, in its early stages of evolution, was carried round with the earth's axial motion, all the while just grazing the surface, and that its distance therefrom increased through countless ages, and is increasing. The inference denotes a Jovian moon in embryo."

Is Jupiter Launching a Moon?



From drawing by Scriven Bolton in Illustrated London News

The Great Red Spot on Jupiter's surface is not a fixture of the surface. It moves around. This is noteworthy from the fact that theory tells us that our moon, in its early stages of evolution, was carried round with the earth's axial motion, all the while just grazing the surface, its distance therefrom increasing through countless ages. The inference denotes a Jovian moon in embryo

Serving Yourself to a Shave

You don't tip anybody and you don't have to wait

You step in and do the job yourself as quickly as your personal skill will permit

Down one side of the room are clean, tile-floored, well lighted booths provided with all the necessary shaving equipment

ON FIFTH Avenue in Chicago is the first "shaveteria" ever built. You serve yourself to a shave there, just as you serve yourself with food at a cafeteria.

When you are in a hurry for a shave, and you know that you could do it twice as quickly as it could be done in a barber's chair, you step into the shaveteria. Down one side of the room are clean tile-floored, well-lighted booths. Each is provided with porcelain lavatory, hot and cold running water, and all things necessary.

You do not have to wait. You step right in and do the job up yourself.

A Novel Device for Generating Fresh Air in Submarines

A NEW process for supplying pure air to submarines has been discovered. The inventor, William G. Bond, of Wilmington, Del., recently demonstrated the use of his apparatus by remaining in a test chamber three feet by four feet by six feet for seven hours with only the air furnished by his device. The air is purified by a chemical reaction between carbon dioxide and certain solutions exposed to the atmosphere of the chamber. The carbon is absorbed and the oxygen liberated.

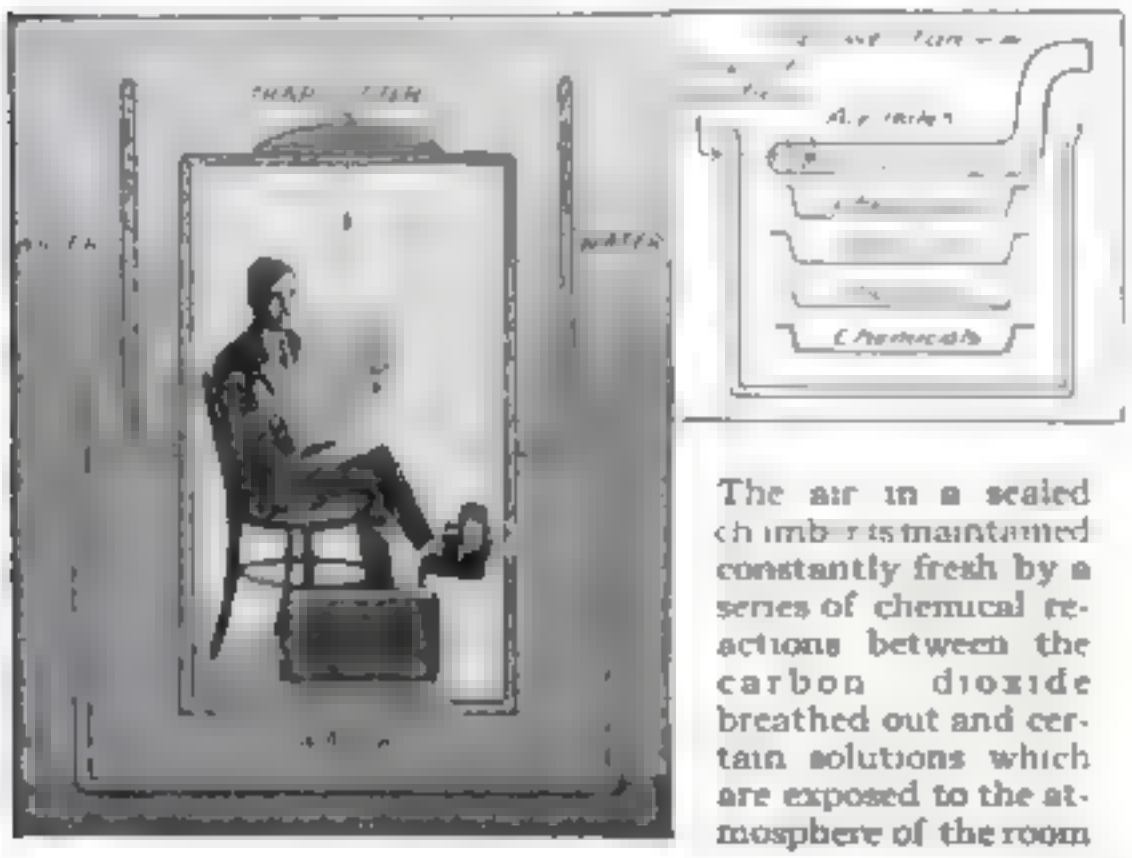
The test room used was entirely surrounded by water. Mr. Bond entered the tank, clad in a bathing suit and supplied with reading matter, food, air-testing apparatus and the chemicals. He kept in communication with the observers on the outside by means of a telephone. At a stated time, the supply of oxygen furnished by the apparatus was cut off and he remained for three-quarters of an hour longer. Though the air had been perfectly wholesome for seven hours, at the end of the forty-five minutes the inventor emerged breathing very heavily.

The value of this discovery to the submarine is yet undetermined. Its advantages are the simplicity of operation and the low cost of installation and maintenance. Let it be said, however, that any practicable method for ventilation of the submarine will be welcomed.

An electric lantern is cleaner, cheaper, and gives a much brighter light than kerosene

Electric Hand Lantern Costs Less Than a Kerosene Burner

AN electric hand lantern has just been placed on the market for people who have a use for the hand lantern, but who find most of them too expensive. It sells for the sum of twenty-five cents and gives as good a light as many of the more expensive models. The lamp proper is a tungsten burner which is turned on and off by a screw. It is six inches high.

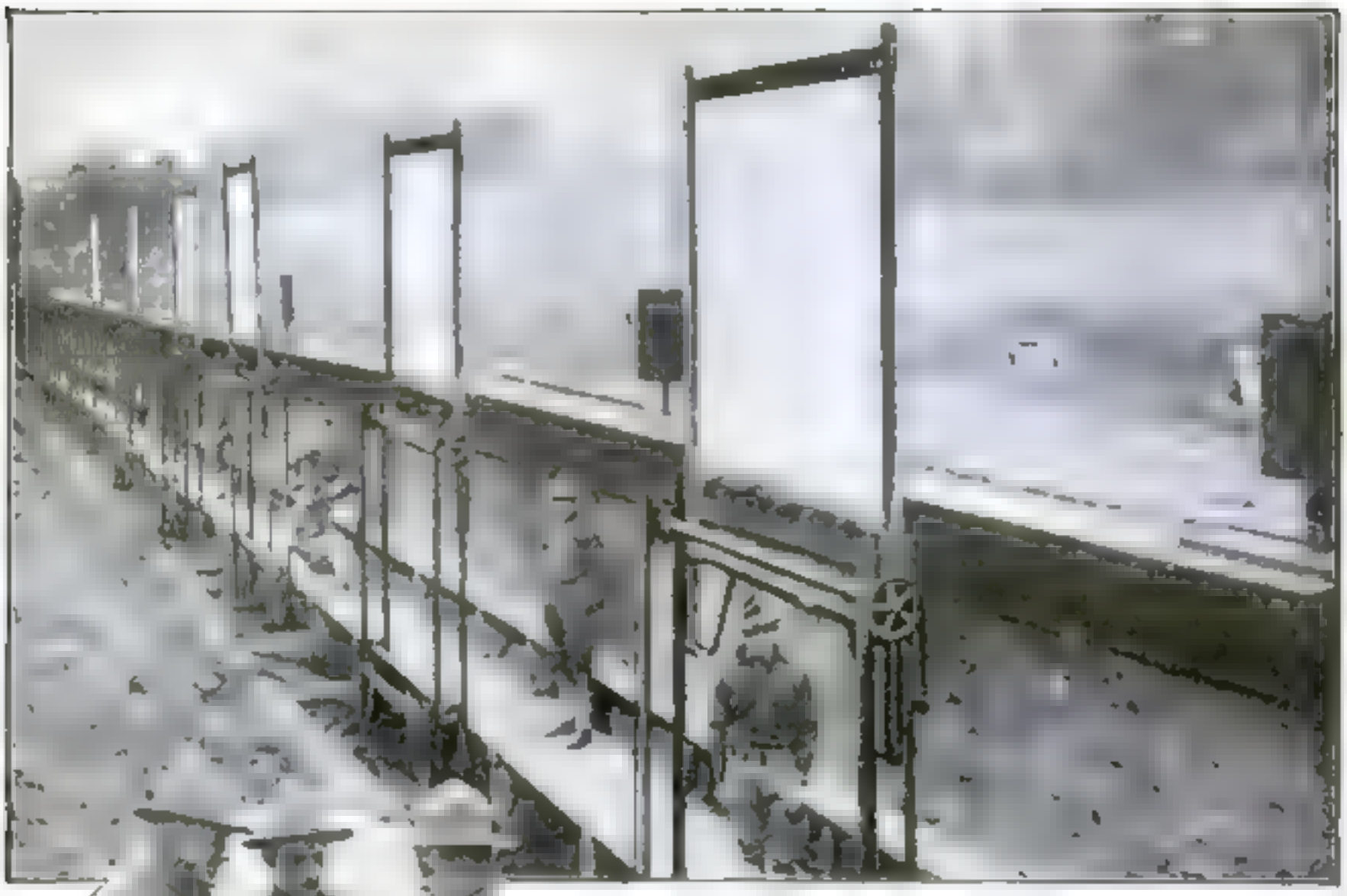


The air in a sealed chamber is maintained constantly fresh by a series of chemical reactions between the carbon dioxide breathed out and certain solutions which are exposed to the atmosphere of the room

Electric Ranges Are Becoming Popular

ONE of the most promising developments of the present time is the increasing use of electric ranges in the home. This is especially true in Canada where the rates are remarkably low. In many cities, the price per kilowatt-hour is less than three cents, and in some it is as low as one cent. The main objection lies in the fact that an electric stove installation is expensive. Tearing out old wiring and replacing it with new is almost as costly as the range itself. Thus the best and most economical plan is to make the proper installation when the house is first built.

Using the Telephone on the Rifle Range



On the rifle range of the Georgia State Militia at Augusta, scoring is done by a telephone system. A telephone in the firing pit is operated from a central station box on the firing line; so is an iron buzzer box in front of each target. When the buzzer sounds, the target is pulled down, the shot located and another target set up

At left, the telephone box on the firing line. The operator keeps in constant communication with the men in the firing pit by means of the telephone and the buzzers located one at each target

Below, a busy firing line. As one target is pulled down and the shot noted the target in the other lash goes up automatically, so that a target is always in place above the pit. The buzzer-cords to the pit are led through the pipe line shown

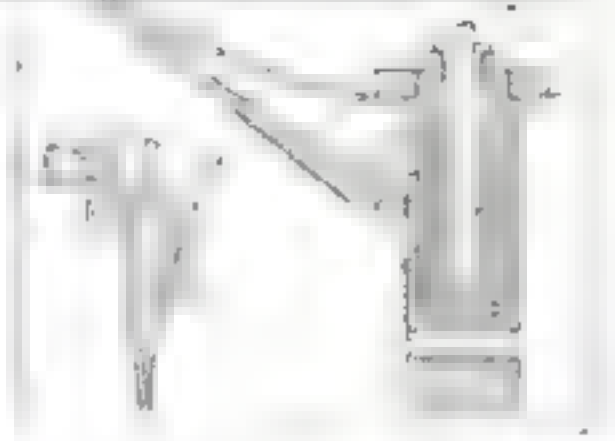
Two Mines Which Make Marine Warfare More Terrible

THE accompanying illustrations show two different types of mines which have been devised since the great war started. The mine with the periscope attached is said to be the latest Teuton lure for British skippers who are seeking the $2,500 reward offered by the British Admiralty for ramming a submarine. Not long ago one of these periscope mines was sighted in the English channel by a steamship captain. Taking it for the periscope of a submarine the captain ordered all speed ahead, in an attempt to ram what he thought to be a lurking U-boat. As he was fast approaching it he noticed, to his bewilderment, that it did not move. He became suspicious and when almost upon the periscope ordered his pilot to give it wide berth. Later he investigated cautiously and found that the periscope was attached to a huge mine.

The other mine is the invention of Giovanni Elia, of Paris, who believes that it is the most effective of any mine now in use. His mine cannot explode by coming in contact with strong tides or striking slight obstructions in the water.

It is anchored, and, when a moving ship comes in contact with it, a shock is produced which is absorbed entirely by the circular frame projecting from the body of the mine. Under the influence of this shock three screws in the firing mechanism are cut through.

In the meantime the mine, having come in contact with the vessel, turns, under the effect of the friction of the hull of the ship. This turning movement cocks a striker and then releases it, causing the explosion. The mine can be manipulated and transported without danger prior to its being submerged.



Above: The periscope mine—the Teuton lure for British skippers. The periscope is merely attached to the top of an anchored mine. At left: A mine which cannot explode unless struck by the hull of a ship. The circular frame is a shock absorber

The Deepest Known Place in the Ocean

THE greatest ocean depth known is 5,269 fathoms, or 31,614 feet. It is about seventy-five miles southeast of the Island of Guam. This figure was obtained in 1899 by the U.S.S. Nero when running a line of soundings to locate the Honolulu-Manila cable. The mean depth of the entire ocean is about 2,100 fathoms, or 12,600 feet.

While the condemned horse eats, the gas enters the air-tight stall, causing him to die peacefully and painlessly

A Humane Method of Destroying Horses with Illuminating Gas

A NEW equipment for killing condemned horses with illuminating gas has been installed in the Denver City Pound. A small air-tight stall is connected with the city gas-main. While the horse is munching his oats or hay from a manger in one side of the stall, the gas enters from a pipe directly underneath. The animal gently and peacefully subsides into insensibility.

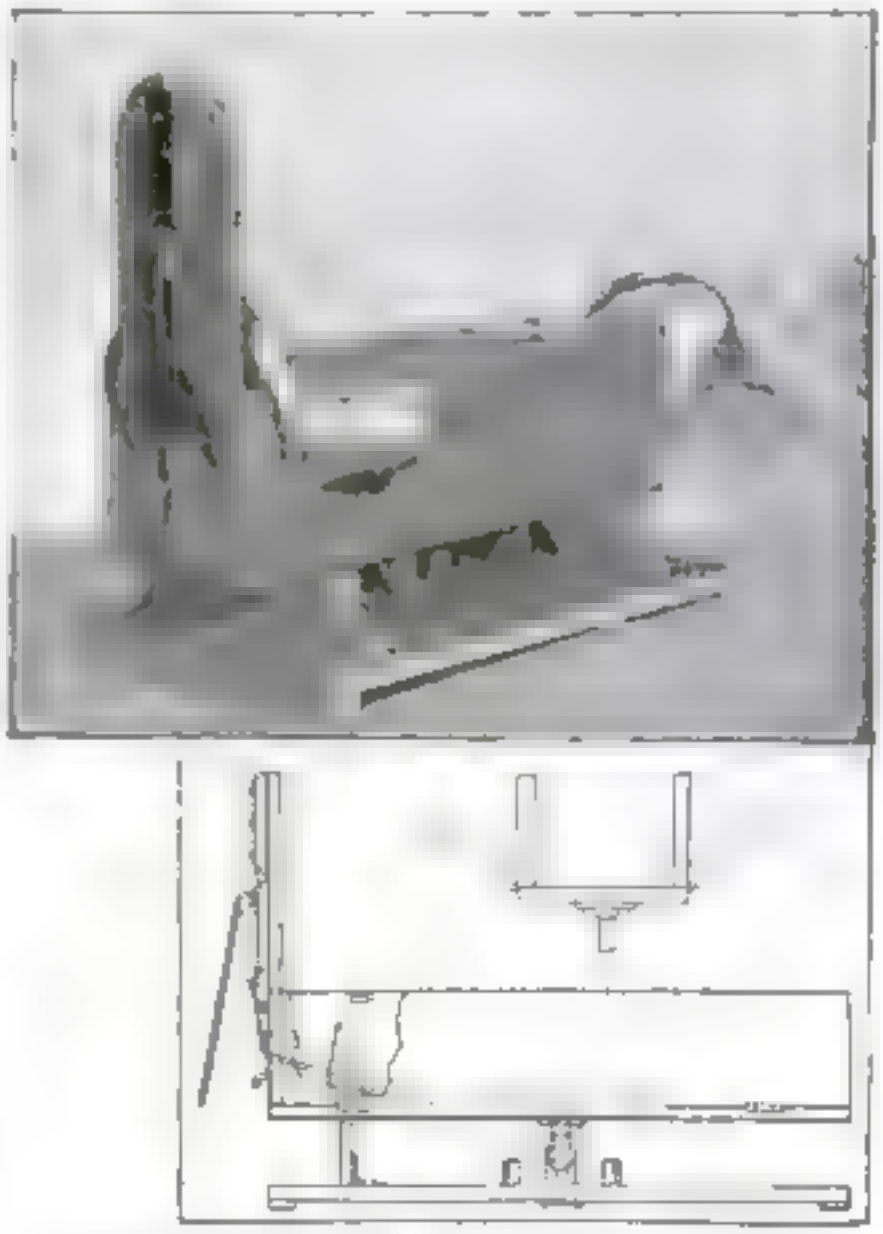
The stall is ten feet long, seven feet six inches high, and four feet wide. It was devised by Walter C. Cox, of Denver, Col., who claims that stables or buildings can be adapted to the purpose by making them air-tight. He has also devised a leather inhaler with a three quarter-inch hose connection and a strap to pass around the horse's nose. The inhaler is used where a stall is not available.

New Apparatus for Setting Broken Bones

THIS apparatus for setting broken leg bones, devised by John B. Hunt, Mansfield, Ohio, makes it possible for the patient to move the injured leg to a limited extent without danger of displacing the fractured ends. The bones are kept in correct alinement, as is customary in surgical practice, by the use of an adjustable weight. But the apparatus for suspending the weight is novel. An overshoe-form is laced over the foot. To this overshoe straps are attached which run over rollers mounted in slots in the upright end-board of the frame. These straps are attached to the weight-strap, which runs up over a roller suspended from a scale. The other end of the strap has a weight attached to it.

Movement of the limb up or down or longitudinally within restricted bounds is possible, as in doing so the suspended weight is raised or lowered without altering the tension on the limb. This alleviates the discomfort, to some degree, of a trying situation.

The sides of the apparatus are hinged to permit of the letting down of either side in order that the limb of the patient may be placed in it easily, as shown in illustration.

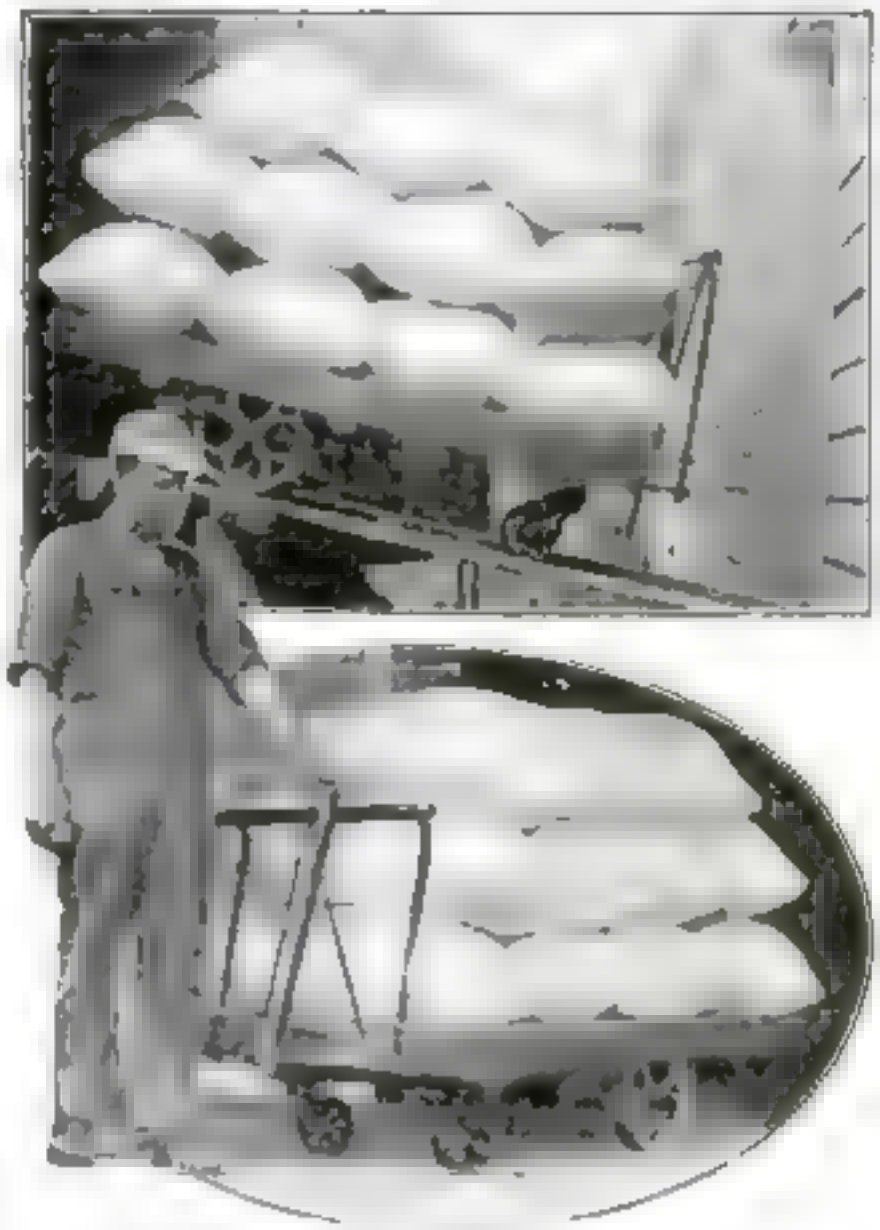


The apparatus in use. Details of the construction, and a cross-section showing how the sides open and close on hinges

Rubber-Ball Fender to Protect Unwary Pedestrians

IF THE plans of a wildly imaginative Texan inventor go through, all motor vehicles will soon be equipped with a huge rubber ball, projecting out in front. And its purpose? Oh, it just gently bumps the careless pedestrian instead of knocking him senseless or dead. What matters it that the ball will be more than a yard in diameter when puffed out to its capacity?

Of course you think that the rubber-ball safety-guard bounces the careless pedestrian to one side, allowing the automobile to proceed on its way. You are wrong. It is intended to envelop the victim in its folds. But that is not all. It applies the brake automatically when a careless man sinks in its expanse. This is accomplished by means of a compressed-air arrangement. Edison will turn green with envy when he reads about this in the POPULAR SCIENCE MONTHLY.



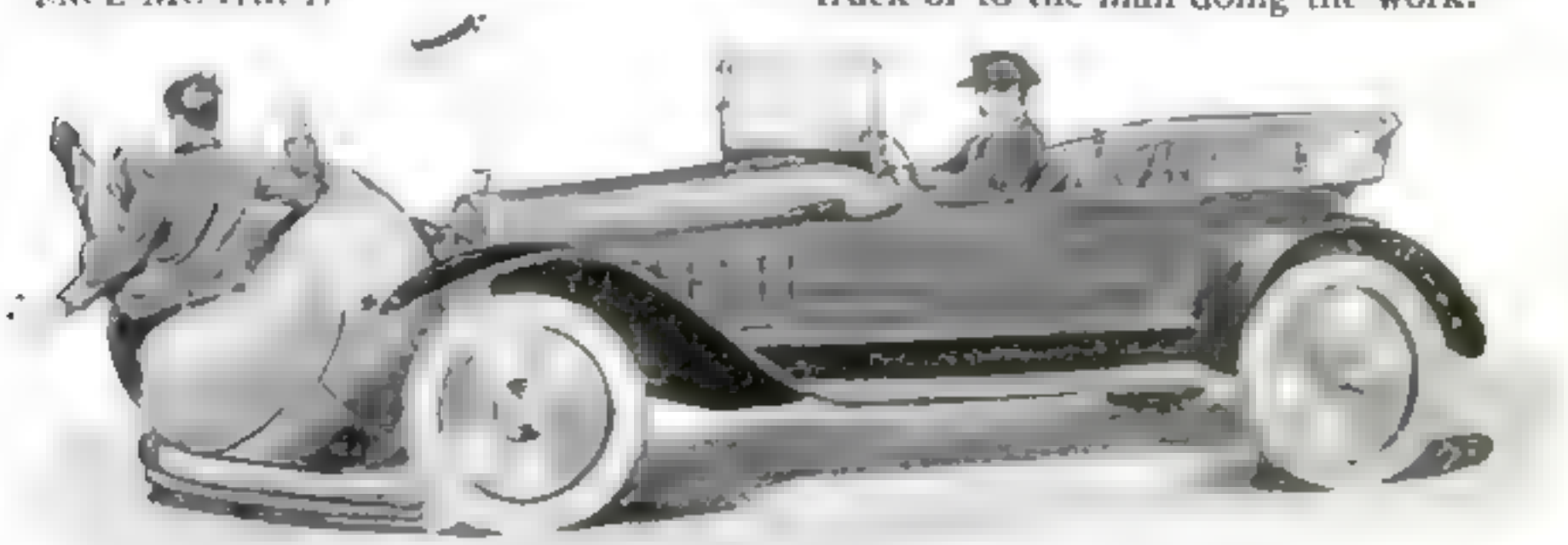
Heavily loaded trucks can be rolled down an incline without danger to the freight

An Automatic Brake for Freight Trucks

A SAFETY-BRAKE which can be applied to the ordinary truck of the kind used in warehouses has been devised by Jacob H. Balkena, of Grandville, Mich. The brake is arranged to bear against opposite portions of the peripheries of the rear wheels of the truck.

The brakes themselves are operated by opposite levers, which, in turn, are connected with a rod extending lengthwise under the body of the truck and operatively connected at its forward end with an upright lever which may be readily grasped and operated by the man handling the truck.

With this brake a truck loaded with eleven hundred pounds of middlings or any other commodity can be safely rolled down a thirty-per cent incline from freight car to warehouse without the slightest danger either to the truck or to the man doing the work.



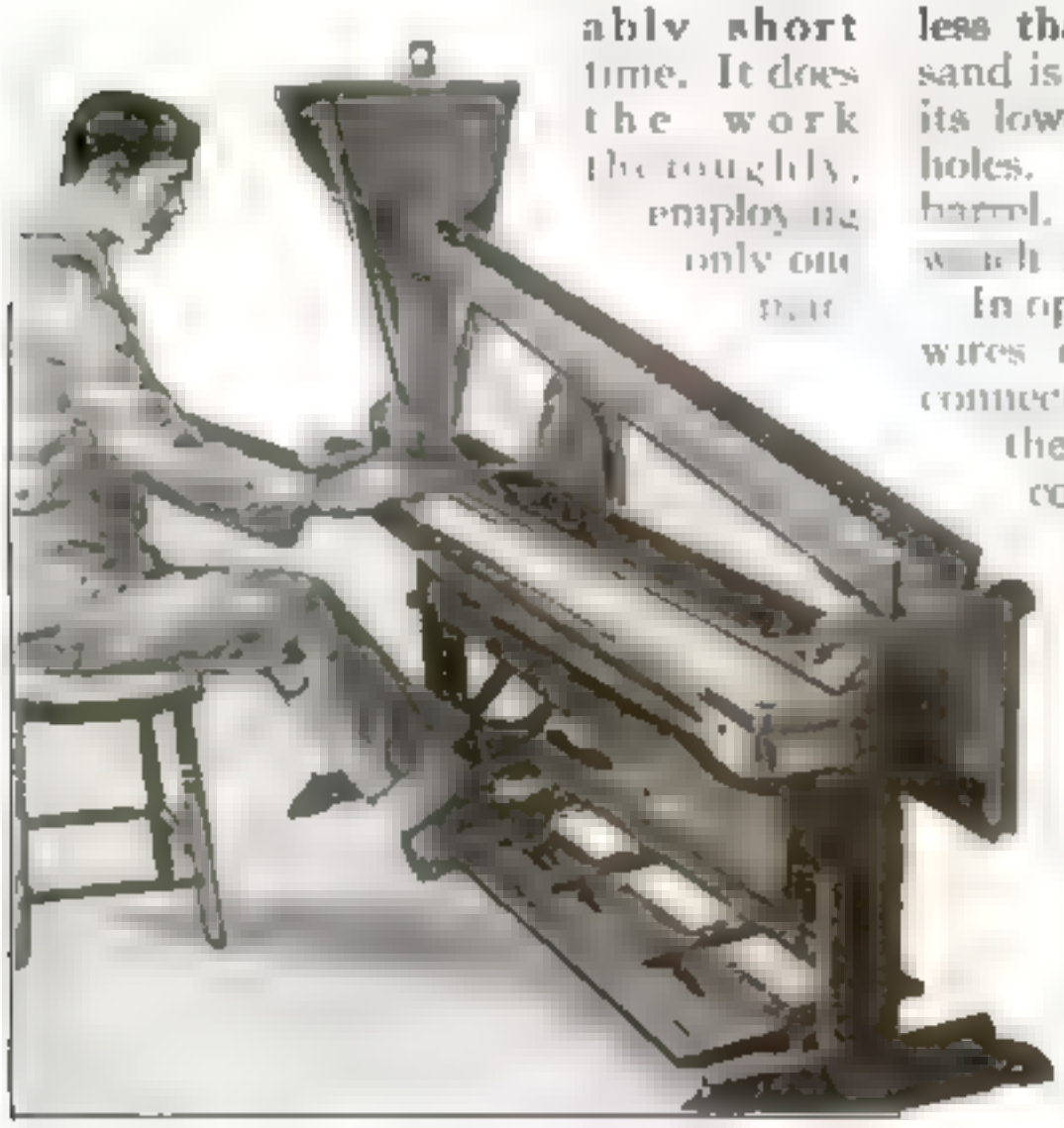
The ball envelops the pedestrian in its folds and automatically applies the brakes

Cleaning and Sorting Beans by Machinery

A MACHINE for cleaning and sorting beans has been invented by D. E. Krause of Sobieska, Wisconsin. First, the beans are poured into a large hopper-like receptacle. From this they are shaken down an inclined chute which has a wire screen as its bottom member.

Undersized beans, small stones and dirt drop through this screening and are thus eliminated. From this inclined chute the clean beans fall down on to an endless conveyer-belt. As the belt rolls along, the workman sitting in front of it picks out any black or imperfect beans.

The device makes it possible to clean and sort a large quantity of beans in a remarkably short time. It does the work thoroughly, employing only one man



One workman using the machine can clean and sort a large quantity of beans in a remarkably short time

Electrical Extraction of Gold from Black Sand

THE black sand concentrates of the placer and quartz mines in western United States contain values in gold as well as in other rare metals. A recent invention based on electrolysis is now being demonstrated in various localities for the extraction of the gold, which often exceeds two hundred dollars per ton.

The water and the electrolyte mix at the head of the trough and in passing the hopper wash the sand down

The principle involved in the operation will be understood by reference to the drawing. Carbon bars are mounted in slots in the sides of a wooden trough twelve inches wide and fit in depressions in the bottom of the trough, these depressions containing a quantity of mercury.

The space allowed between the carbons and the surface of the mercury is less than one-eighth of an inch. The sand is placed in a hopper perforated at its lower edge with a number of small holes. The electrolyte is stored in a barrel. A pipe furnishes pure water, which flows directly into the trough.

In operation, the positive and negative wires of an eight-volt generator are connected with the carbons and with the mercury respectively. The correct amounts of the electrolyte and pure water are turned into the trough. They mix at the head of the trough, and, in passing the hopper, gradually wash the sand down the trough through the space between the carbons and mercury, where the current, acting upon the gold, deposits it in the mercury, with which it amalgamates and from which it is extracted.

To all appearance the sand undergoes no change whatever, but an assay of the tailings seldom gives a trace of the gold.

Steaming Frozen Ground for Gold

OVER much of northern Alaska and British Columbia the ground is forever solidly frozen for many feet beneath the surface. During the warm summer months, where the overlying moss has been removed, the soil may thaw out for a few inches or feet, permitting placer mining to be carried on by hydraulic mining methods. For the most part this natural thawing is far too slow to prove practicable in a region where the working season is only a few months in the year. The ingenuity of man, therefore, has devised a method to assist Nature in her work. Long, hollow tubes, called "steam points," tapered at one end and enlarged at the other to withstand repeated blows and carrying a connection to a steam line, are driven in rows across the face of the ground. Steam under pressure is forced through these pipes for several hours until the section is thoroughly thawed. Then the points are removed and driven into another nearby section.

Much of this work is carried on both at the surface and beneath the ground in drifts, during the winter months, the gravel removed being piled in great dumps to await the summer season of abundant flowing water.

Long, hollow tubes are driven into the ground in rows and steam is forced through them for several hours

Look Out! Perhaps the Man You're Talking to Wears a Detectaphone

A PATENT has been issued to William Heymann, of Washington, D. C., on a device which records on a graphophone drum whispered conversations, without the speaker being aware of the fact. The receiver, which is of the usual detectaphone type, is to be worn beneath the shirtfront, and the electric battery and cylinder of the recording graphophone are to be hooked to the wearer's belt. Release a wound-up clockspring and the needle of the graphophone traces the zigzags produced by the sound waves.

The receiver is worn beneath the shirtfront and the graphophone is hooked on the belt

The paint is first vaporized and then forced through hose and sprayed on the cars by means of compressed air

The Hose Is Mightier and Quicker Than the Brush

IF KIPLING had only waited long enough before saying it our picture might have given him his idea about painting with a comet's tail for a brush and the sky for a canvas. However, the painters shown in the accompanying illustration are not artists and their canvas is not the sky but two brand-new steel box-cars which have just emerged from the shop

This is the fastest and most economical method of painting yet devised. The paint is first vaporized and then forced through the hose and sprayed on the cars by compressed air

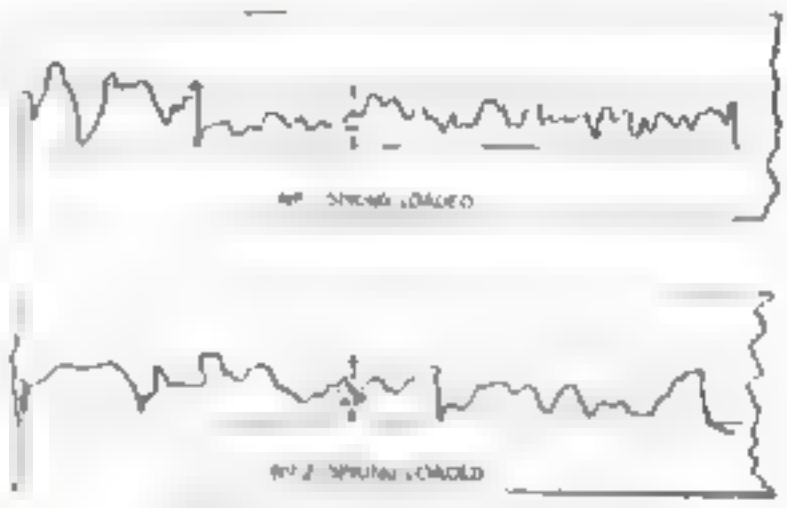
While the photographer was adjusting his camera for a snapshot the ends of both these cars were painted, which gives an idea of how rapidly the work is accomplished.

The device is carried in an open-sided frame attached to the body of the truck at the back of the driver's cab

Recording the Vibrations of a Motor-Truck Spring

THE novel device illustrated was recently designed to enable a truck manufacturing company to judge what springs are best adapted for its vehicles.

The device consists of a hollow drum mounted on a vertical axis and carried in an open-sided box attached to the truck body at the rear of the driver's cab. It is revolved by gearing from the front wheels of the truck through a flexible cable. A blank strip of paper is fed around the outer circumference of the drum from a roll beside it.



Inscription of a record on the strip of paper around the drum

While the truck is running the spring vibration is proportional to the motion between the body, to which the device is fixed, and the axle. This record is inscribed on the sheet around the drum by means of a pencil carried on a swivel by a spring-arm.

Giant Slabs of Marble to Commemorate Abraham Lincoln

THE largest stone in the great Lincoln Memorial has been swung into place. There are three of these slabs of marble all of the same size, and they are reputed to be the largest ever set in any structure in this country. Each is more than six feet high and more than nineteen feet long and weighs about twenty-eight tons.

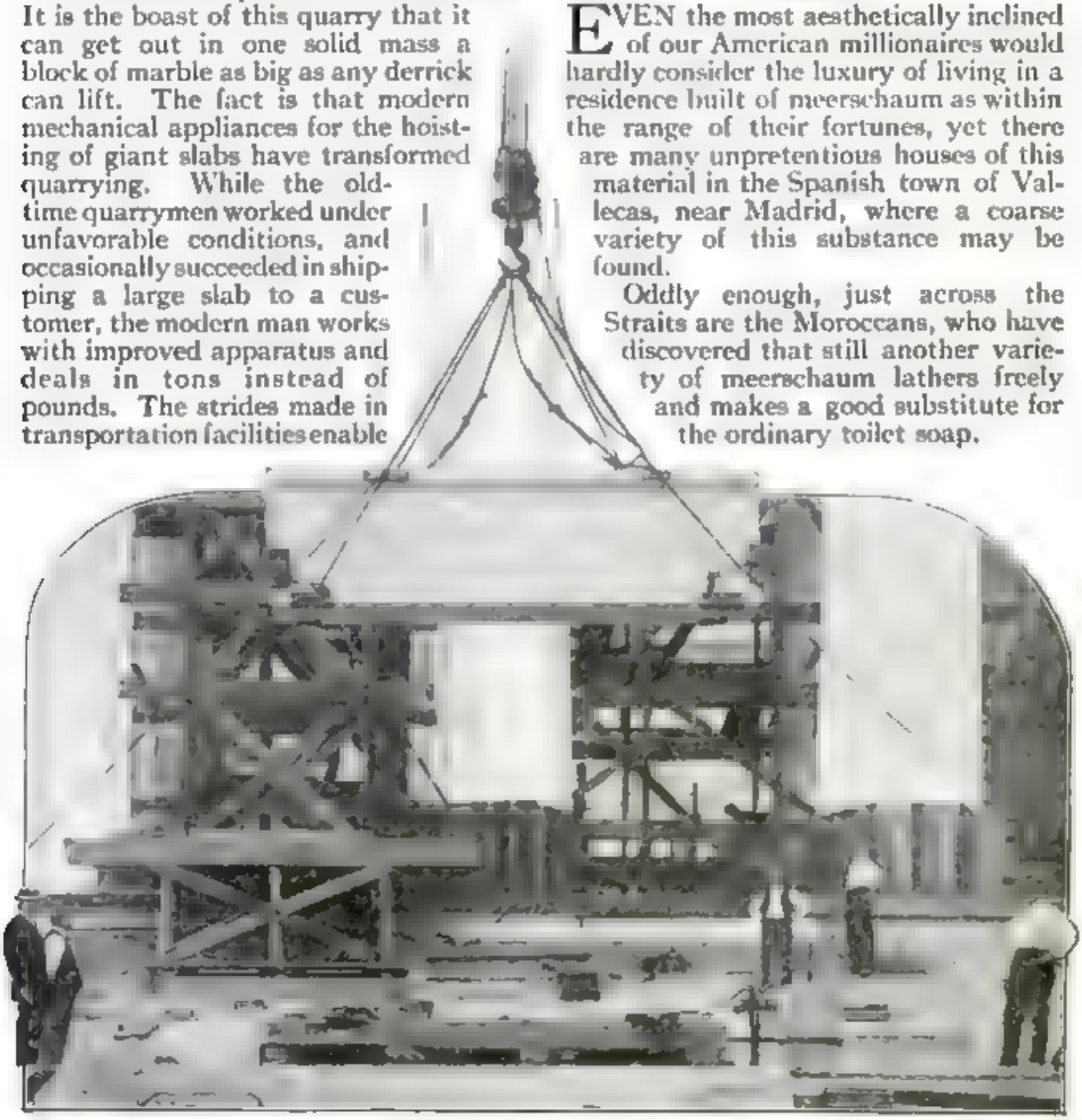
The big blocks came from a quarry in Colorado which is situated just below the perpetual snow-line of the Rockies, on the eastern slope of the Great Divide. It is the boast of this quarry that it can get out in one solid mass a block of marble as big as any derrick can lift. The fact is that modern mechanical appliances for the hoisting of giant slabs have transformed quarrying. While the old-time quarrymen worked under unfavorable conditions, and occasionally succeeded in shipping a large slab to a customer, the modern man works with improved apparatus and deals in tons instead of pounds. The strides made in transportation facilities enable him to ship an expensive piece of stone with the assurance that it will reach its destination safely.

According to Henry Bacon, the architect of the Lincoln Memorial, there are more than eight hundred pieces of stone in the structure. These weigh from twelve to twenty-five tons each. No other piece of architecture in the world can boast of such construction. It reminds one of the giant stones of the pyramids of Egypt.

Meerschaum as a Building Material in Spain

EVEN the most aesthetically inclined of our American millionaires would hardly consider the luxury of living in a residence built of meerschaum as within the range of their fortunes, yet there are many unpretentious houses of this material in the Spanish town of Vallecas, near Madrid, where a coarse variety of this substance may be found.

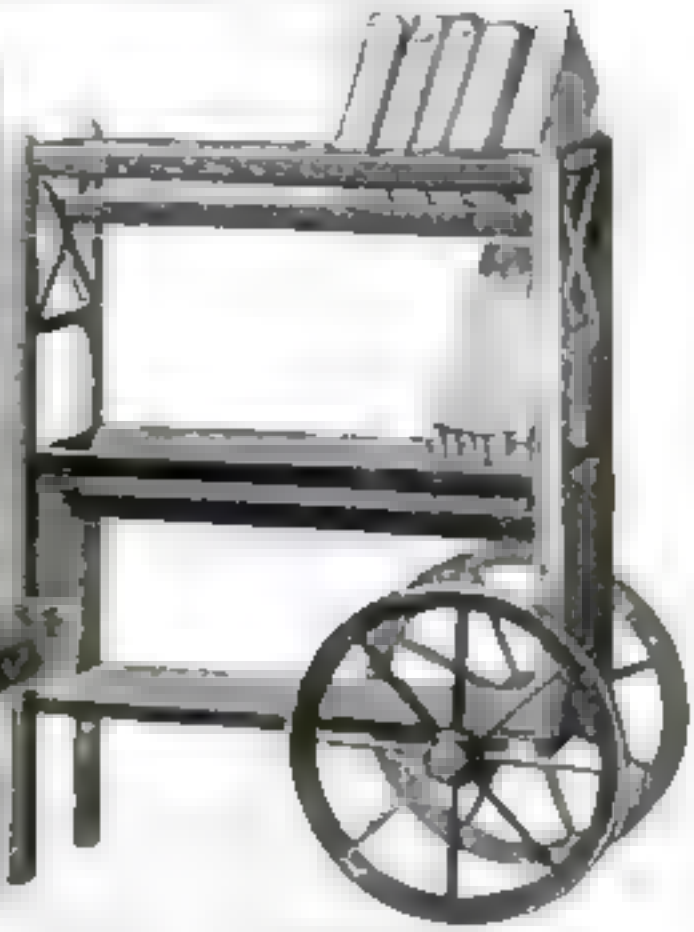
Oddly enough, just across the Straits are the Moroccans, who have discovered that still another variety of meerschaum lathers freely and makes a good substitute for the ordinary toilet soap.



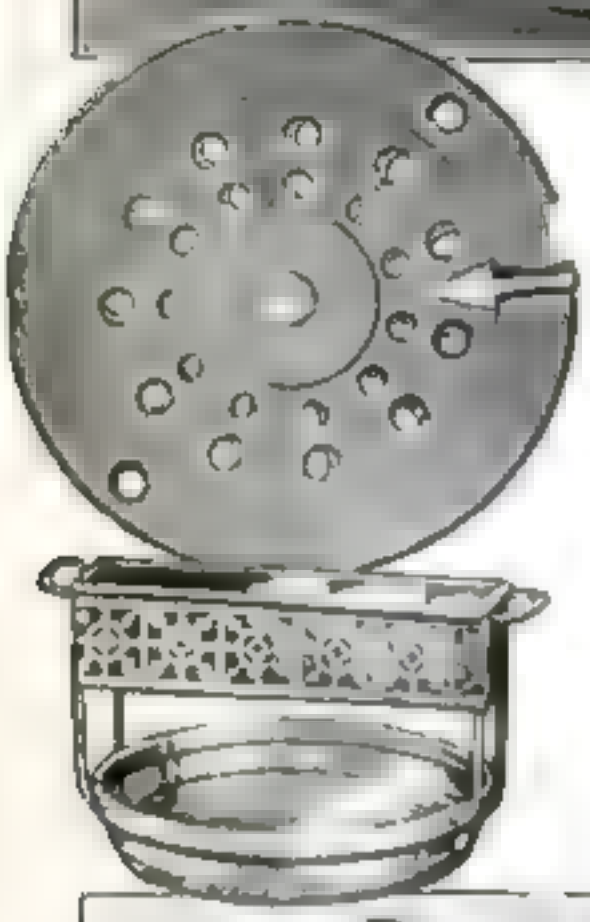
The largest pieces of marble ever set in any structure in this country have been swung into place in the Lincoln Memorial. Each one of these giant slabs weighs twenty-eight tons

There's No Place Like a Mechanical Home

Above: An automobile seat converted into a handsome and comfortable porch rocker



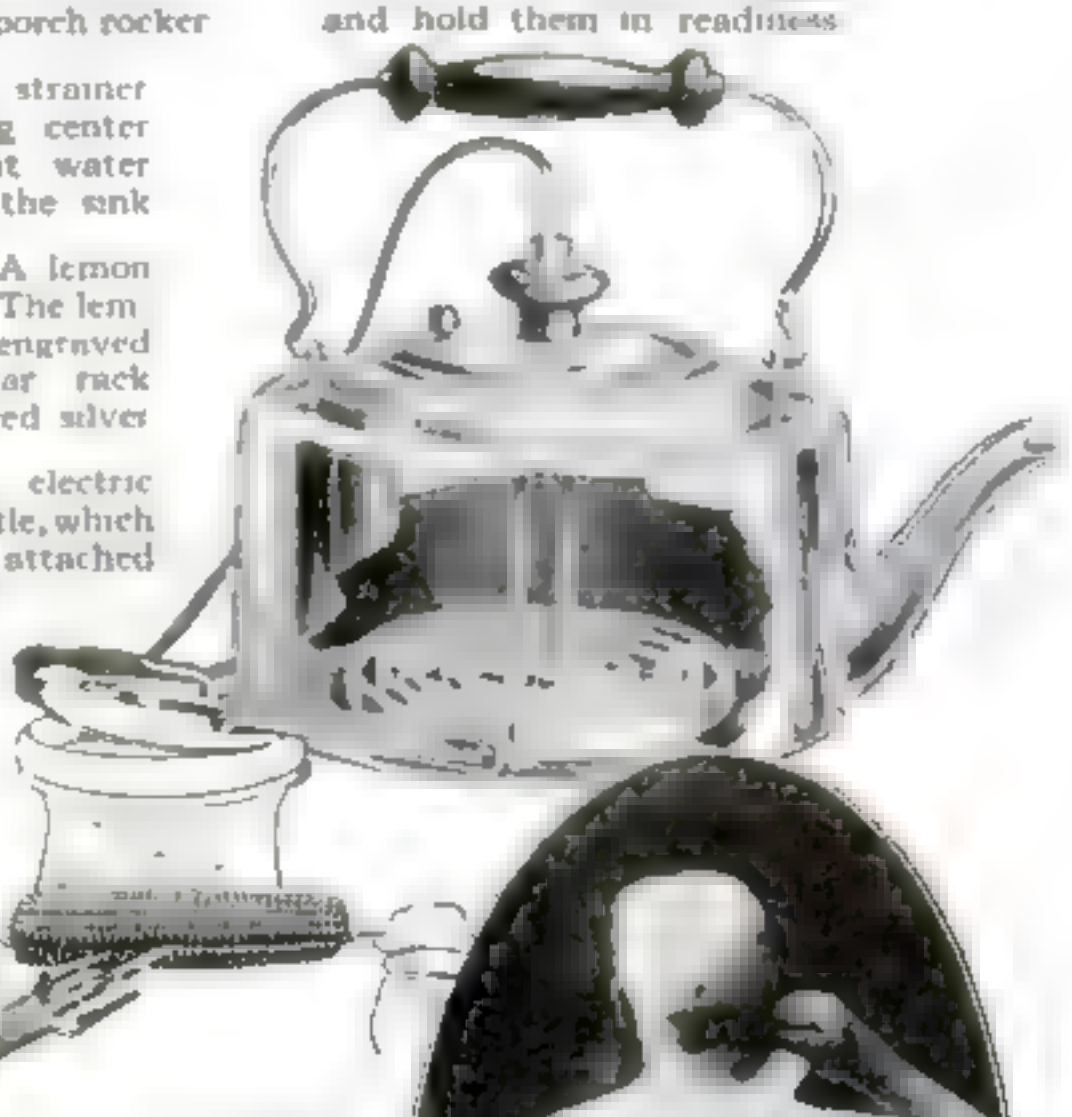
Above: A mahogany book wagon will carry your books and hold them in readiness



At left. A sink strainer with a revolving center plate to prevent water running out of the sink

At left below: A lemon and sugar dish. The lemon dish is of engraved glass the sugar rack above is of pierced silver

At right: An electric heater for the kettle, which can be readily attached



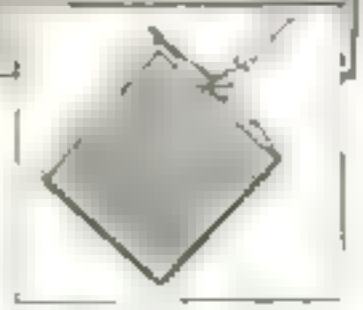
Above: A combined corn-holder, nut-pick and bottle-opener. It is most effective in holding an ear of corn

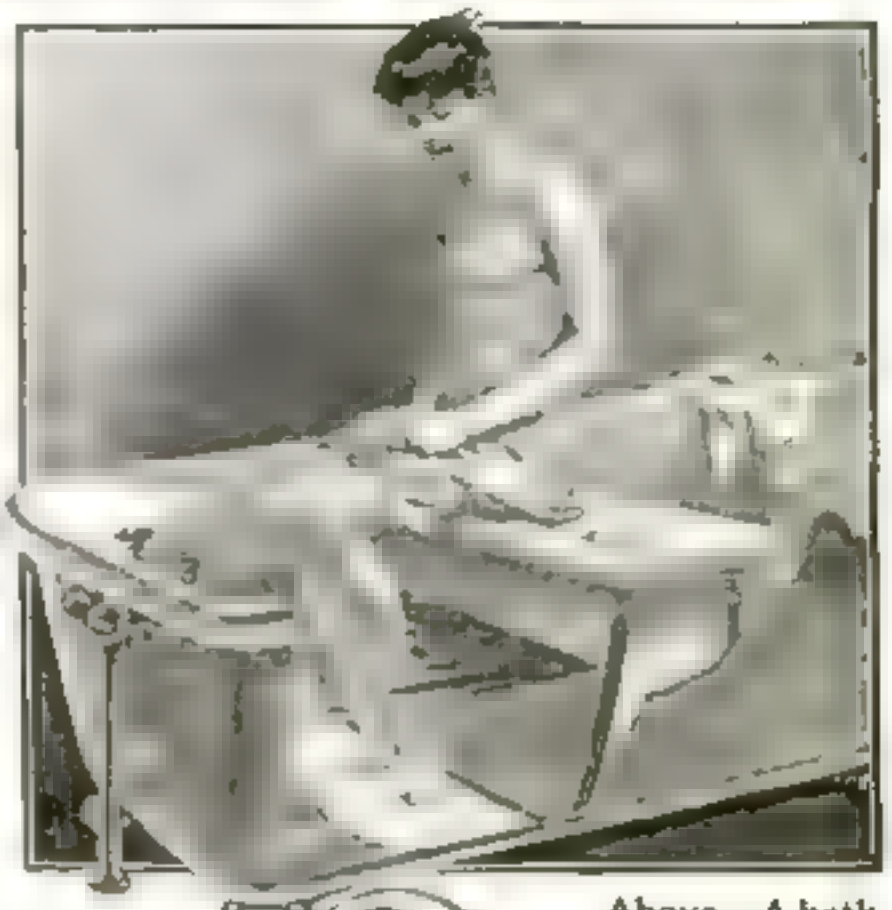
At left: A floor-brush constructed like a fountain pen. The handle is hollow. It contains water which is automatically fed to brush

At right: A flesh brush attached to a strap makes it easy to scrub your back

Here They Are: The Newest Things for the Home

Above: A shovel ash-sifter which saves coal The ashes sift down into the shovel and the lumps of usable coal or coke remain on top

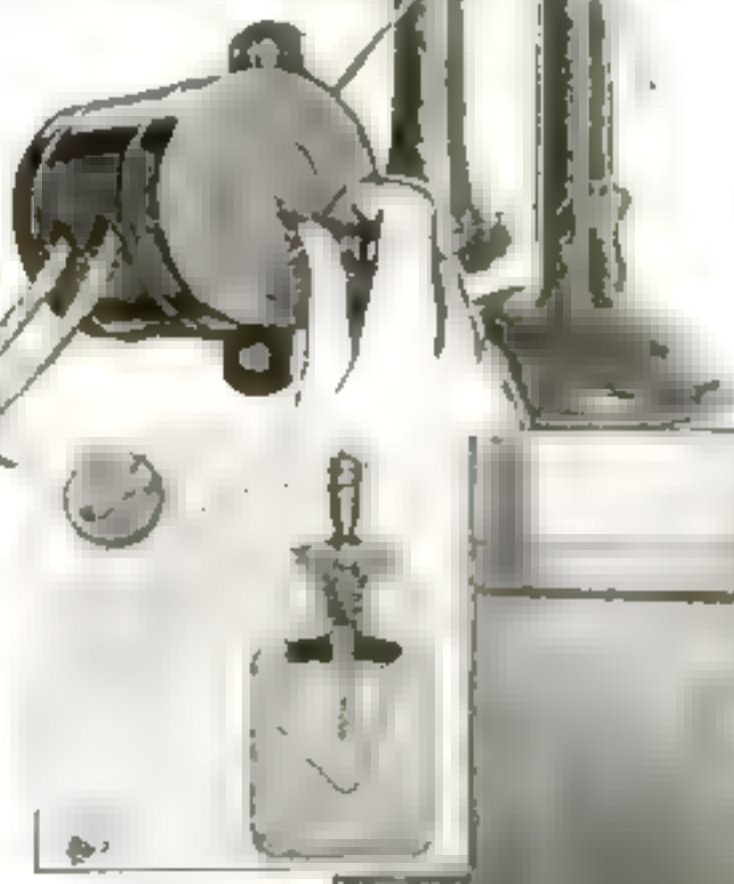




Above A bath-tub seat which partitions off a part of the tub so that it can be used as a foot bath, sitz-bath or for bathing little children

At left: A collapsible utensil holder and strainer which can be expanded to fit pans of almost any size

Below: A clothesline holder with the rope wound around a spool



At left: A telephone lock which clasps the standard just above the receiver-hook. It is built in three curved sections and operates like a bracket

Above: A hot water-bottle heated by a resistance coil in a hollow tube

At left: A foot rest fastened to the radiator affords an excellent means of warming the feet

At right: A small electric motor freezes the ice-cream. Connection is made with any available electric light socket

Our Bad Tempers

What makes you angry? Why do you fly in a rage when the soup is salty? Blame it on your grandfather

By G. Davenport

THAT bad temper is due more to an inside state than to outside conditions is demonstrated by the fact that the same mild stimulus causes so much more violent behavior in some individuals than in others. In other words it takes little or nothing to make some persons lose their temper. They lose it easily, just as children do, because they lack the braking power or ability to shut off this violent reaction. Liability to outbursts of temper is confined to no stratum of intellect or social position. The choleric may be rich or poor, stupid or intelligent. Bad temper is an emotional rather than a mental disturbance. Concerning the causes of this disturbance we know little. We know that over-eating and drinking, bad digestion, intestinal stagnation and exciting situations are contributory factors. But what may cause an irritable state in one may not ruffle another. To account for this difference, we are brought around again to the matter of individual constitution, *i. e.*, to the fact of heredity. In many cases that have come under institutional observation there is not infrequently a regular occurrence of tantrums at monthly or more frequent intervals. It would seem as though there were an accumulation of some substance in the body, in consequence of which the nervous system becomes so irritable that an explosion results from the most trivial cause.

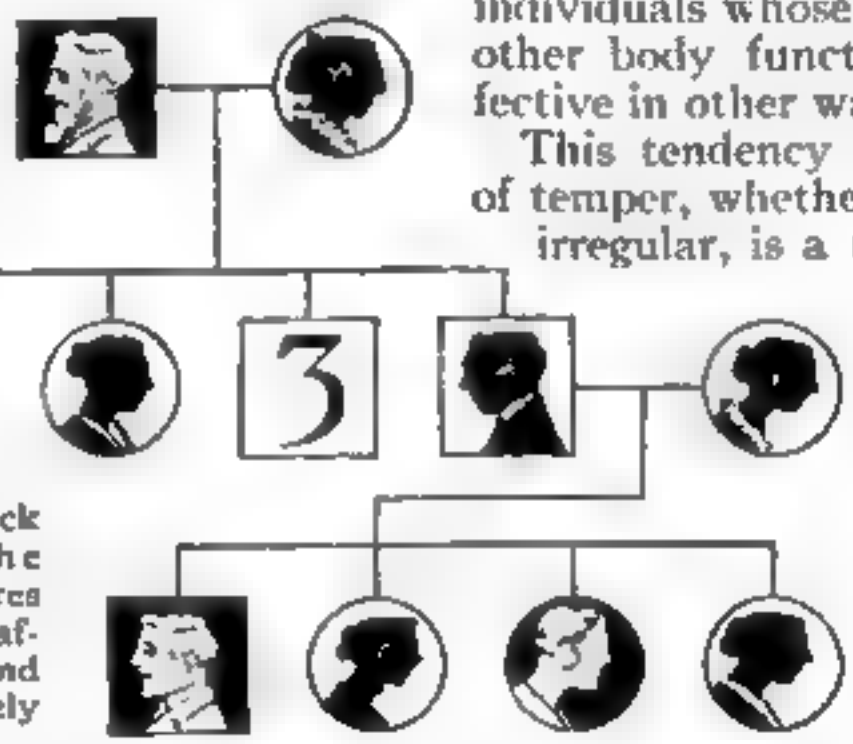


Chart 1. The black profiles in the circles and squares represent the affected females and males respectively

Bad temper is especially frequent in families that contain epileptic, hysterical or insane relatives. Epilepsy and insanity, however, are not necessarily indicated by outbursts of temper nor does a choleric temper invariably accompany these disorders; for there are mild tempered epileptics as well as maniacs. The paralysis of the braking mechanism upon which tantrums depend, seems, however, to occur most readily in those individuals whose nervous and other body functions are defective in other ways.

This tendency to outbursts of temper, whether periodic or irregular, is a return to an infantile emotional condition. Children are more given to displays of temper, on the whole, than are adults, just as monkeys are much more capricious, on the whole, than men. Thus ill-tempered families have either reverted, in this respect, to a more primitive condition or else they are retarded in the evolution of this trait.

Whatever may be the racial history of the trait, its present hereditary behavior is not obscure. We know that it is handed down in certain families from generation to generation without a break. That is to say, some members of each generation will possess this unsocial trait and others lack it. Those that show it, transmit it in turn; but those without it cannot do so. Traits that do not skip a generation are known in the language of modern heredity as dominant traits. Just how complete may be the dominance will depend on the hereditary history of both parents. There is an hereditary combination possible that will produce 100 per cent choleric; that is when both parents are choleric and belong to pure choleric strains.

The accompanying charts illustrate

the law of the inheritance of this trait. The circles represent females and the squares males. The black profiles in the circles and squares represent the affected females and males respectively. Chart 1 starts with a female—a grandmother who had three bad-tempered children, two sons and one daughter. One son married a bad-tempered woman. Two of his daughters are notoriously ill-natured. One of them is under custodial care.

That the shrewish do not always hark back to female progenitors is well illustrated in Chart 2, which includes five generations. In this chart the first fiery-tempered progenitor of whom we can get record is a great-great-grandfather. He has transmitted tantrums through son, grandson, great-grandson to his great-great-grand daughter, whose behavior is such that she should end her days in the state institution in which she is now an inmate.

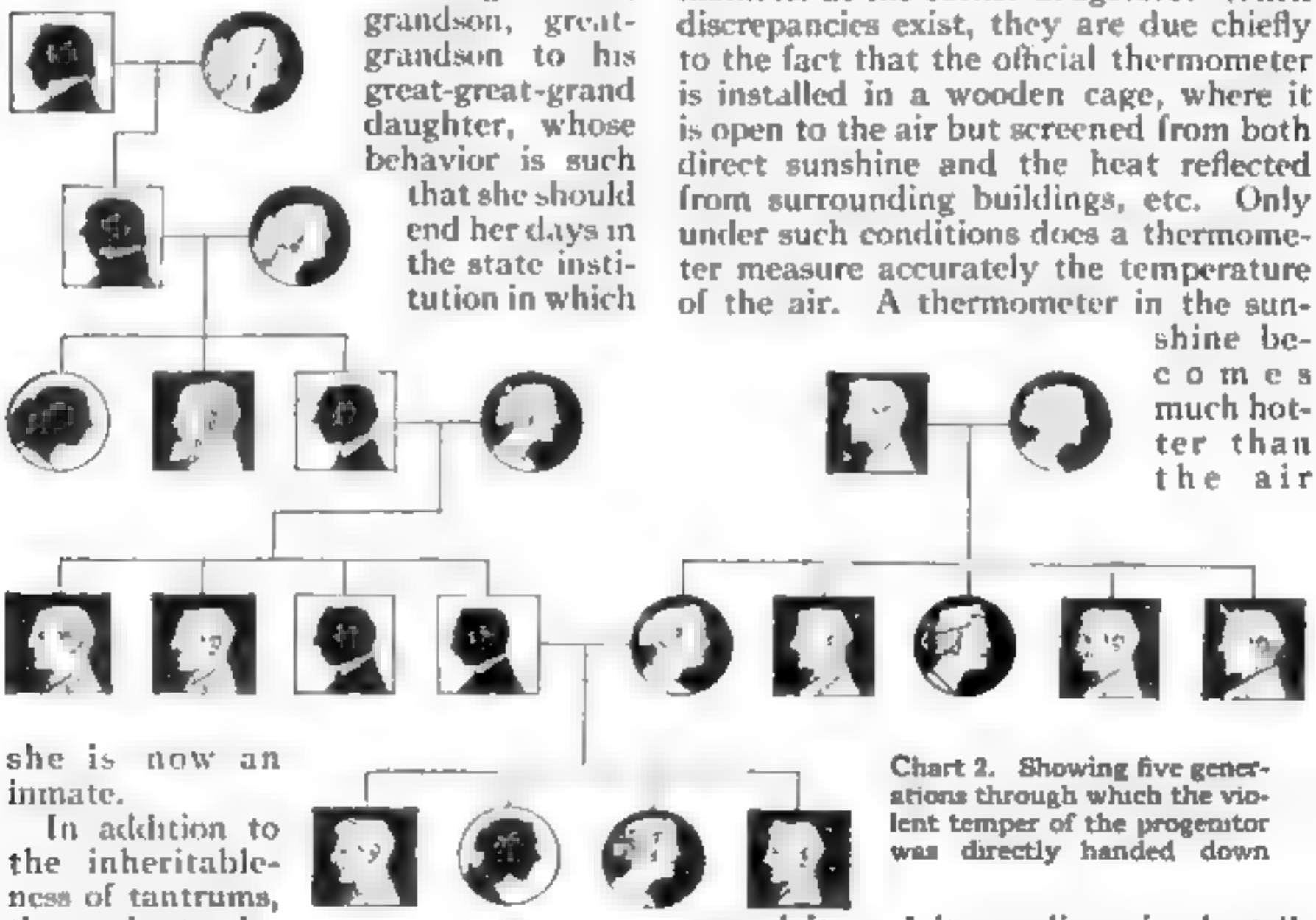


Chart 2. Showing five generations through which the violent temper of the progenitor was directly handed down

In addition to the inheritableness of tantrums, these charts demonstrate that bad temper is one of the contributory causes that fill our houses of correction. These institutional cases come almost wholly from the unintelligent. Intelligent and conscientious persons will wish to do everything in their power to control temper. Abstemiousness in food and drink, sufficient sleep and attention to health in general, may avail something. The imminent outbursts may be counteracted by physical exercise or a prolonged, soothing bath. The internal irritants seem to be destroyed or gotten rid of by these means. Much may be accomplished by establishing the habit, even at great effort, of ignoring irritating situations. When the intellect is too weak to cope with the situation or the temper is so furious as to be beyond treatment, then custodial care is advisable both from the standpoint of the individual and of society.

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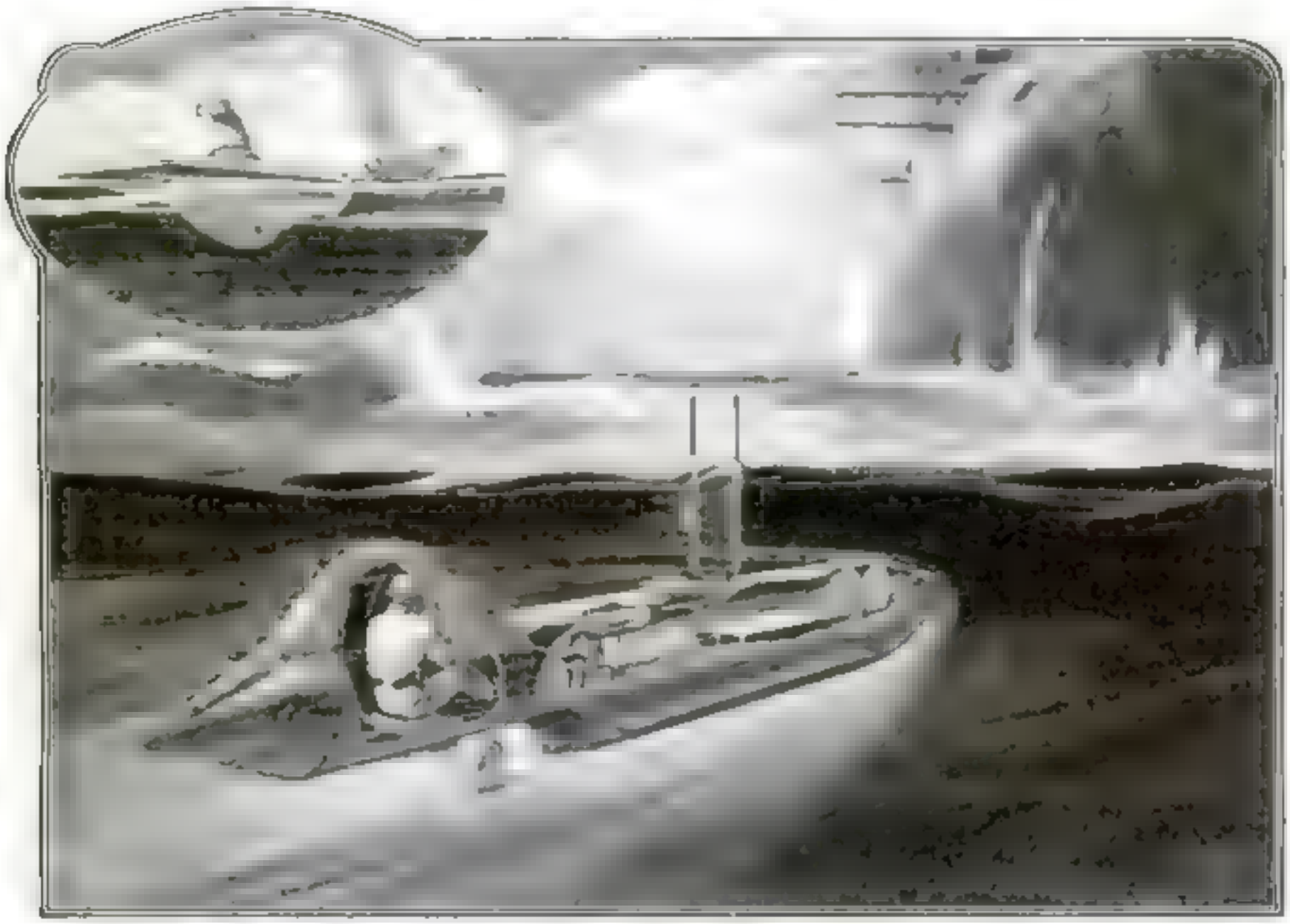
The Difference Between a Store Thermometer and an Official Thermometer

WHY does a Weather Bureau thermometer show lower temperatures in hot weather than the thermometer at the corner drugstore? When discrepancies exist, they are due chiefly to the fact that the official thermometer is installed in a wooden cage, where it is open to the air but screened from both direct sunshine and the heat reflected from surrounding buildings, etc. Only under such conditions does a thermometer measure accurately the temperature of the air. A thermometer in the sunshine becomes much hotter than the air around it, and its reading simply tells us how hot the instrument is, not how hot the air is. In large cities the Weather Bureau thermometer is often installed on the roof of a high building, where the temperatures differ somewhat from those prevailing at the street level. The object sought in this arrangement is to obtain a record of the natural temperature of the locality in general, rather than the artificial temperatures of the city.

A Deadly Man-Steered Torpedo

Would you pilot five hundred pounds of gun-cotton toward a hostile battleship and brave gun-fire?



When the torpedo has been released the weight of the conning tower section causes it to keel over, thus forming a kind of canoe in which the pilot paddles back to his vessel

THE modern Whitehead automobile torpedo is by far the most feared weapon of modern naval warfare. It is, in effect, a little automatic submarine boat, with engines and rudders controlled by a mechanical brain. The soul of the torpedo is the gyroscope—a flywheel spinning at several thousand revolutions per minute. Unfortunately, this flywheel loses speed from the moment of launching. Modern naval battles are fought at ranges of five to ten miles. The Whitehead torpedo is inaccurate at such distances. Indeed, in the whole history of naval warfare the torpedo has reached its target only at short ranges.

Among the plans which have been suggested for increasing the effectiveness of the torpedo, perhaps the most daring is that of providing it with a real brain and a real controlling hand in the shape of a man. Commander Davis of the United States Navy, designed a little vessel, some years ago, which was to contain a huge explosive charge and which was to be guided by a super-bold mariner against a battleship amid a storm of bullets. That men will volunteer for such hazardous work recent wars have abundantly demonstrated. We have only to remember how the Merrimac was sunk in the mouth of Santiago harbor, during the Spanish-American war, in the effort to imprison the Spanish ships believed to lie within. Dozens of men volunteered to block the channel under the fire of Spanish guns.

Hence, when Jacob S. Walch, of Walla Walla, Washington, suggests a torpedo

controlled by a pilot carried along on its flight, we can well believe that he has not underestimated human courage.

He builds his torpedo so that the part in which the pilot sits may be detached after the explosive charge has been released to proceed under its own automatic control.

The detachable, pilot-carrying portion is attached to the main body of the torpedo and the various levers and controlling devices are all within the reach of the operator. When the torpedo is traveling on the surface of the water, partly submerged, the compressed air used by the engine may be taken from an air-chamber, which is in communication with the atmosphere, through vertical tubes resembling periscopes. When the torpedo is to be submerged to a greater depth the tubes are lowered and the engine is then supplied with gas from a compressed-gas tank. The depth of submergence may be regulated by the inclination of planes at the side of the body.

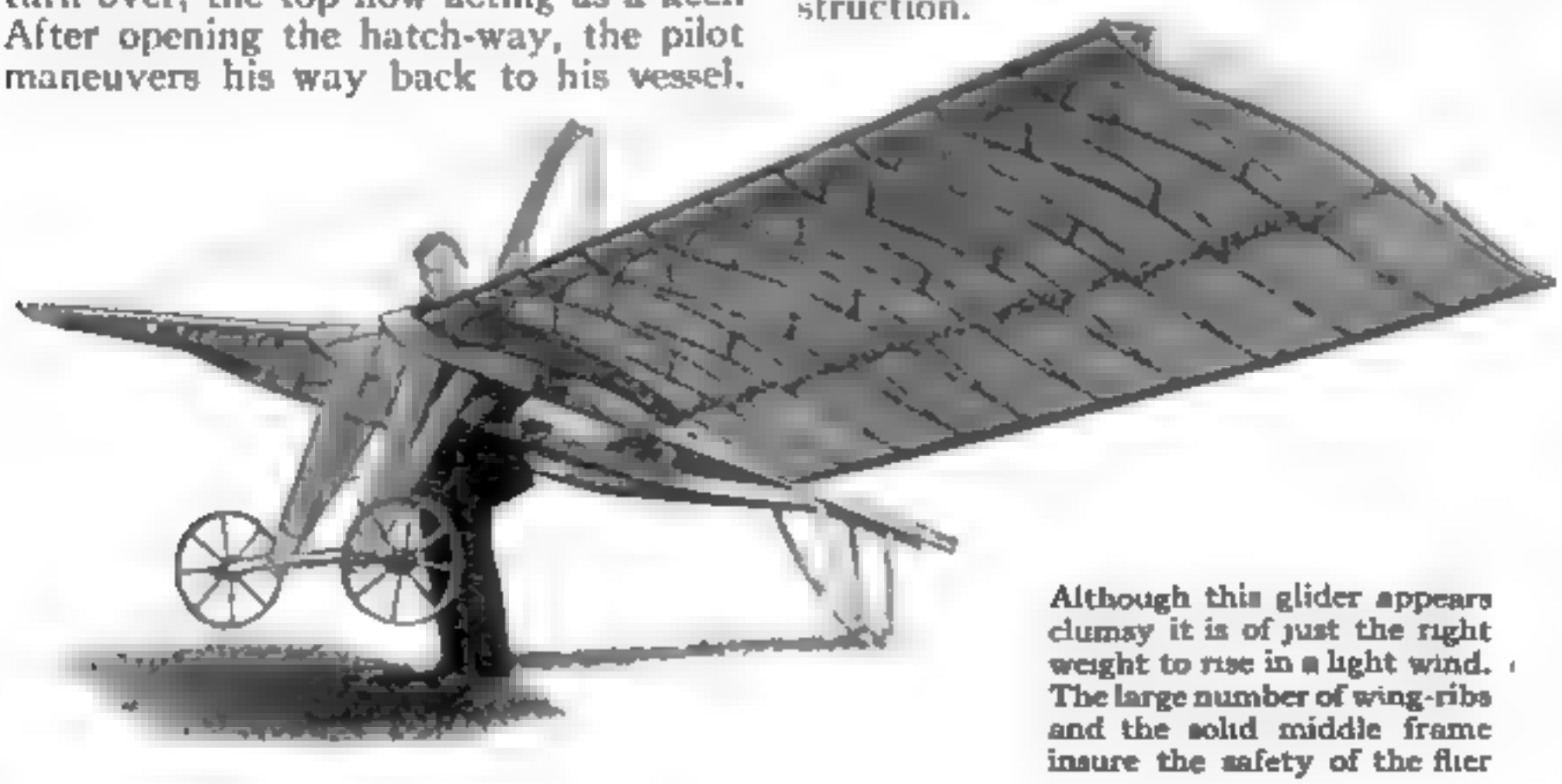
When the torpedo has been brought to proper striking distance by the pilot, who has meanwhile fixed the control for the correct course and the proper submergence, a rod is operated which causes pressure from the compressed air tank to separate the torpedo body from the pilot section. As soon as the pilot section is free from the main body of the torpedo, the weight of the conning-tower portion causes the section to turn over, the top now acting as a keel. After opening the hatch-way, the pilot maneuvers his way back to his vessel.

The Air-Glider Which a German Boy Is Building

WHILE his father and big brothers are away fighting for the Kaiser, the German boy is taking a renewed interest in aeronautics. The accompanying photograph shows a new one-man aeroplane or glider which contains principles of construction embodied in all the flying machines which are making history these days. The glider is thoroughly typical of our modern aeroplane.

Its perfect rigidity under varying pressures and its never-changing form of wing-surface made possible by the thick, solid middle frame, the deep trussing and the large number of wing-ribs, insure a safe and enjoyable sport for the boy. Although this glider has the appearance of being clumsy and heavy, it is of just the right weight to rise in a light wind and carry the flier a considerable distance.

There is a noticeable contrast between this glider and the Lilienthal models, which are overloaded by the weight of the operator. The latter are much lighter in construction, since the frame is made of willow wands. Professor Langley told in 1896 how attempts to fly his models were frustrated by an uncontrollable "steering" action of wings that were imperceptibly changing shape under pressures. It is interesting to note that the Wright brothers, pioneers of aviation, first learned the rudiments of flying by using gliders of their own construction.



Although this glider appears clumsy it is of just the right weight to rise in a light wind. The large number of wing-ribs and the solid middle frame insure the safety of the flier

Using the X-Ray on Animals

A laboratory for finding out what ails injured horses, cows, cats, dogs, and birds

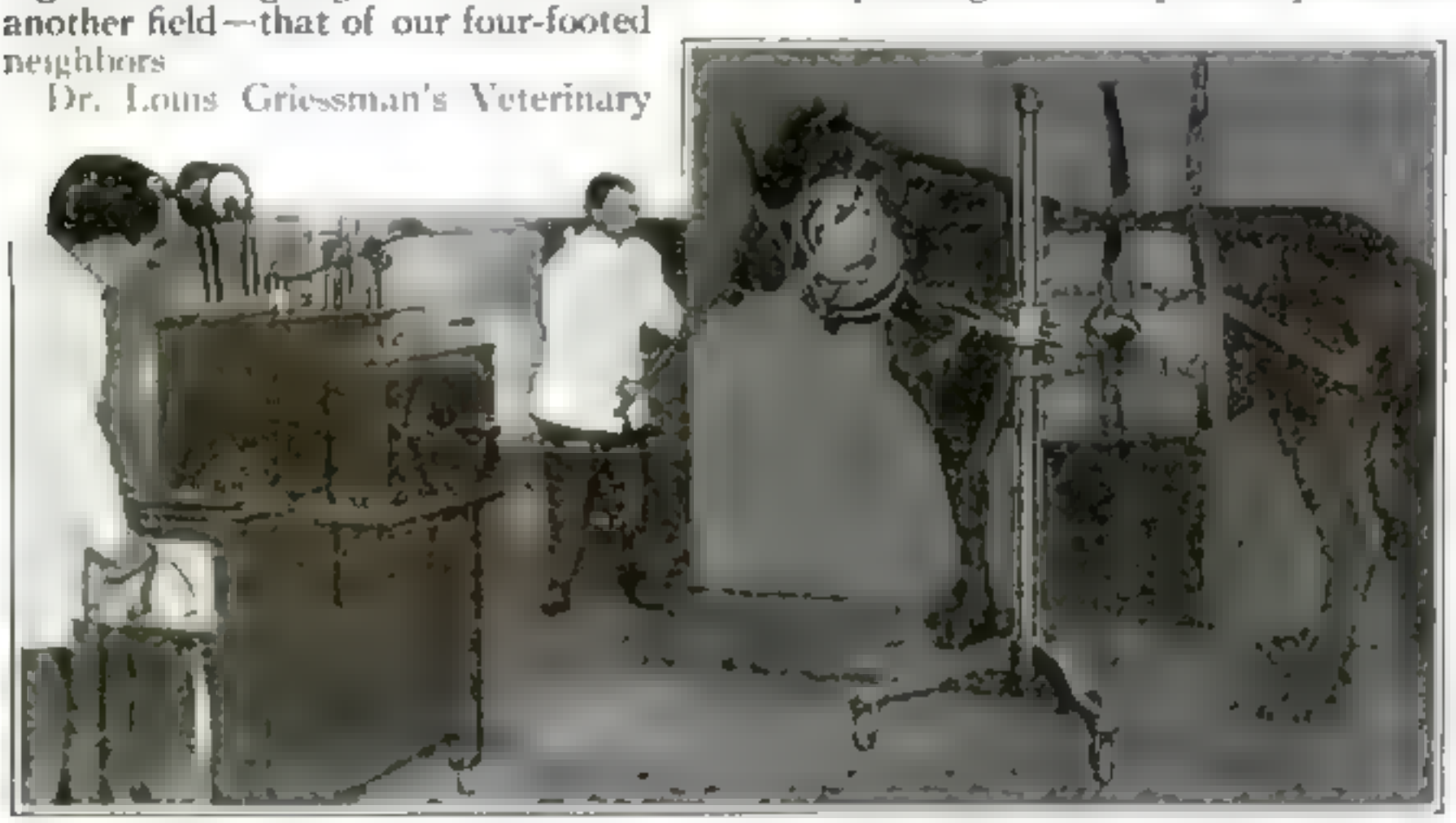
WHILE medical annals have been recording the marvelous work of the X-Ray in saving human life, and volumes have been written of the work of the great experimenters, a New York doctor has been carrying this saving light of science into another field—that of our four-footed neighbors

Dr. Louis Griessman's Veterinary Hospital and X-Ray Laboratory, for the treatment of horses, dogs, cats, birds, and all kinds of pets, is the only one, so far as known, in the world. Certain experimental work along this line has been done in the University of Colorado, but Dr. Griessman is the only man to organize an institution for carrying on practical work.

He has personally diagnosed under the X-Ray hundreds of cases of bone diseases, fractures, dislocations, heart enlargements and tubercular conditions, of various tissues and organs. His subjects have been horses, dogs, cows, cats, chickens, canaries and monkeys. His laboratories are equipped for handling all kinds of animals.

For horses and cows he has constructed a tilting table operated by an electric motor. The horse stands beside the table while it is in a vertical position. He is put in a sling and shackled, and, when all is ready, the table returns to a horizontal position.

Dr. Griessman has invented a means for suspending the X-Ray tube by the use of pulleys and wires so that it can be conveniently swung to any point. Innumerable difficulties encountered in handling the service in Dr. Griessman's Hospital were overcome by Mr. Frank V. McGirr, a young electrical engineer.



A tilting table operated by an electric motor is used for examining horses and cows. The animal is put in a sling, shackled and bound to the up-tilted table

Coal-Mine Fatalities in the United States During 1915

THERE has been a gratifying decrease in the number of fatalities occurring in coal mines in the United States during 1915. The number reported during the year was 2,264, as compared with 2,454 in 1914, and 2,785 in 1913. The actual number killed during 1915 was the lowest for any year since 1906, when there were 2,138 fatalities.

A Simple Instrument Which Measures the Height of a Tree

EXPERIENCED foresters become expert in judging off-hand the height of average timber. By merely looking at a tree of medium height they are able to make a guess with a degree of accuracy that is sufficient for roughly estimating the number of board feet of lumber it contains. But in the case of timber two hundred feet or more in height even the most expert woodsman is apt to make an error of from ten to twenty feet in his calculations. Errors of this kind greatly impair the value of an estimate of the amount of timber in a tract that perhaps is measured by hundreds of acres.

By the use of the hypsometer, however, the height of the tallest of timber can be ascertained with a remarkable degree of accuracy. There are a number of types of hypsometers, but all of them operate on about the same principle.

The height of a tree can be accurately measured by looking through a slot. The figures are noted on a celluloid scale as on the left

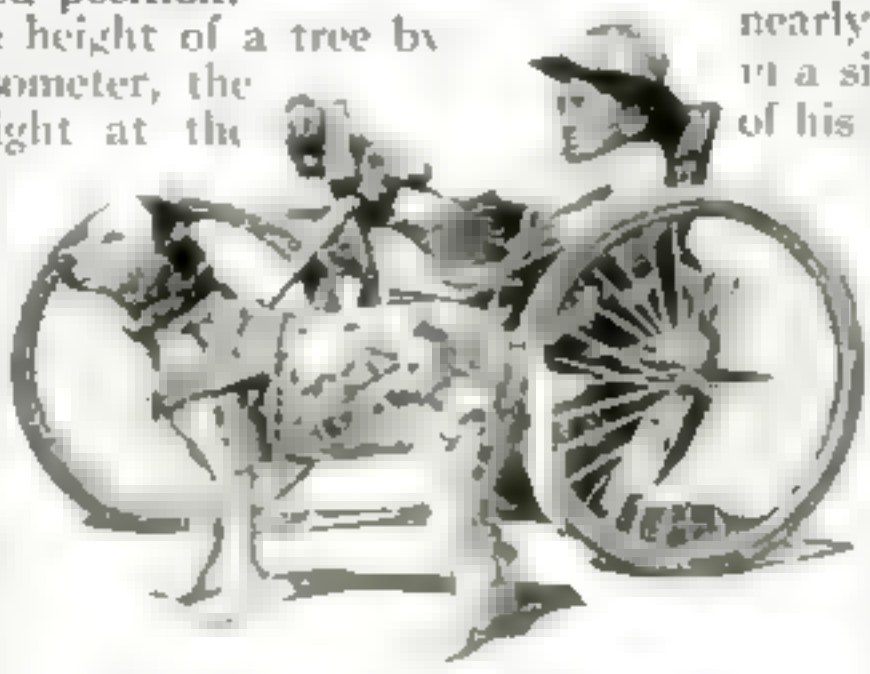
One that has been adopted by the Forest Service consists of a round instrument about four or five inches in diameter and an inch in thickness. To one side is attached a convenient handle. Within the instrument there is a device which operates on the principle of a pendulum. Attached to this is a celluloid scale. On the outer edge of the instrument is a small peep-hole on one side and opposite it a square window-like opening somewhat larger in size. There is a convenient device for securing the pendulum at a fixed position.

To ascertain the height of a tree by means of the hypsometer, the operator takes a sight at the proper point on its trunk by looking through the peep-hole and out through the opening on the opposite side of the instrument. Three different heights figure in timber calculations. One is called the merchantable length. In making certain estimates the "clear" length is ascertained, while in other instances consideration is given only to the height from the ground to the first limb of appreciable size.

The height of the tree governs the angle at which the operator holds the hypsometer in taking the sight.

In His Merry "Dogmobile." How a Cripple Gets Along in the World

ALTHOUGH he is a cripple, R. A. Burdick of Los Angeles, has traveled nearly five thousand miles in a single year with the aid of his pet dog Trix. The dog is harnessed to a specially built tricycle equipped with handlebars, headlight, taillight and a seat similar to that used on wheel-chairs.



The dog is harnessed to a specially constructed and equipped tricycle wheel chair

He sells newspapers and chewing gum. When he wishes to stop he presses a leather pad to the wheel, and the dog stops immediately.

The bee's stinging apparatus as shown up by the microscope. It consists of a sheath within which move two barbed lancets. These form a hollow tube for the poison

The Honeybee's Infernal Machine

IN proportion to its size, the sting of the honeybee is probably the most effective infernal machine in existence. The stinging apparatus is smaller than that of a rattlesnake, yet a single sting has been known to kill a man. When we realize that it is almost invisible, and consider what it can do, we cannot fail to be astounded. It seems the very quintessence of devilishness.

The honeybee's sting is complicated—so complicated that many words and much ink have been used in discussing its construction and use. It is generally conceded that the sting consists of a shaft of three parts, the principal one being a sheath within which move two barbed lancets. Like the barbs of a fish-hook, the lancets are not easily extracted from the flesh into which they have been driven. The sheath and the lancets combined form a hollow tube through which the poison flows from the poison-sac. Two hairy, soft projections, evidently very sensitive, inform the bee when she is in contact with a stingable object.

A snake's fangs are harmless when removed from the snake. Not so the bee's sting. Man, with all his ingenuity, has not yet devised a machine or a thrower of poison gas that will continue to act after the soldier is dead, but nature has done something like it in the honeybee.

At one time it was supposed that the poison that accompanies the sting is formic acid. That is now doubted, although the material has an acid reaction. It is a curious fact that there are other poison glands in the bee that are alkaline. A well-known investigator asserts that the secretion of both sets of glands must be mixed to be fully effective. The secretions enter the barbs. Here the two are mixed, later to be forced out of the channel formed by the sheath and lancets and through certain openings in the lancets. Both the channel in question and the openings were formerly supposed to be merely passages for the poison. It has been shown by a skilful investigator that the channels in the lancets are not connected with the poison duct, and that they are smelling organs, used probably in gathering the nectar for the making of honey.

There is a long list of remedies for the honeybee's sting, all of them worthless. Rubbing or even touching the injured spot does positive harm, because the friction or the pressure forces the poison into the circulation and may intensify pain which would otherwise be only trifling. A well-known authority says, "There is no remedy in the world like letting an ordinary sting alone and going on with the work without even thinking about it."

At times, with no apparent provocation, honeybees will sting a horse or a cow to death within a few minutes; at others they may be thrown around and handled roughly with no more danger than if they were flies. I have shaken the contents of a hive over the bare arms and necks of young ladies without the slightest injury to any one. Again, one may only walk by a hive and be stung.

Here It Is: The New Shaving Harness That Carries Brush, Mug, and Mirror

ANOTHER device has been invented to reduce man's misery as he writhes under the razor. This time it is a shaving-harness. The mirror, shaving-brush and shaving-cup are all attached to the harness in positions convenient to the hand. Armed with this equipment a three days' growth of beard can be attacked with absolute certainty that the task will be completed without the usual contortions of the head and neck.

The frame which holds the mirror is carried on lazy tongs and is hooked over the shoulders. The lazy tongs have a sliding mounting so that the mirror can be moved out or in as far as desired. Furthermore, the mirror swings on a pivot to any convenient angle.

Holders are provided for the brush and shaving-cup. The brush is a little beyond the mirror, and the cup-holder is attached to the frame where it fits against the body. Evidently the inventor, Vicente Aldrete, of Philadelphia, has not considered the use of shaving-sticks and powdered soap. It would be possible, however, to make the cup-holding ring small enough to fit a shaving-stick. The harness is collapsible and can be neatly folded away.

The frame, holding the mirror, mug and brush, is hooked loosely over the shoulders

With this lock, an automobile robe, rain coat or other article can be safely left in the car

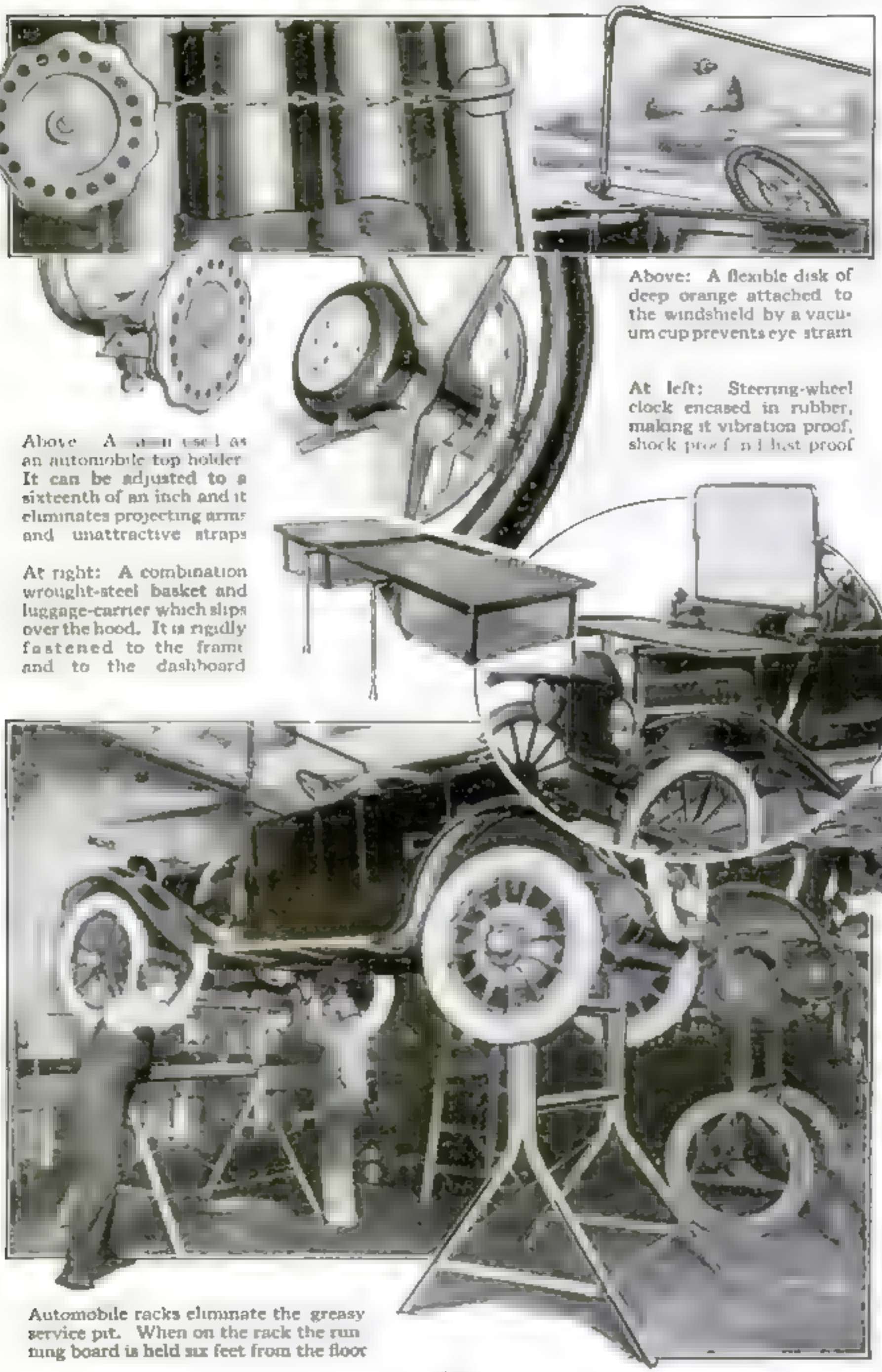
When You Leave the Automobile, Lock the Robes!

A THIEF finds little difficulty in removing the robes from automobiles left standing unoccupied at the curb. But a lock has now been invented which is designed to clamp the robe so securely that it can not be removed from the rod over which it is hung without cutting the robe or otherwise damaging it so that it loses all value as a merchantable article for the thief. Raincoats and other articles may be secured in the same way

The lock is operated by a combination, so that there is no key to be lost. The only essential is a clear head to remember the combination. When not in use the lock is left clamped over the rod where it is not a disfigurement, being of neat-looking nickel-plated steel construction three-quarters of an inch high and two and one-quarter inches wide when closed. Several of them might be kept in the automobile ready for use when needed, to insure the safety of the robes or other articles left there.

The lock will also be found convenient for holding the robes and coats out of the way and for preventing them from slipping to the floor when they are not required for use. With a little ingenuity they may be made to hold any number of shopping parcels.

Is the Automobile Inventor Earning His



Above: A flexible disk of deep orange attached to the windshield by a vacuum cup prevents eye strain

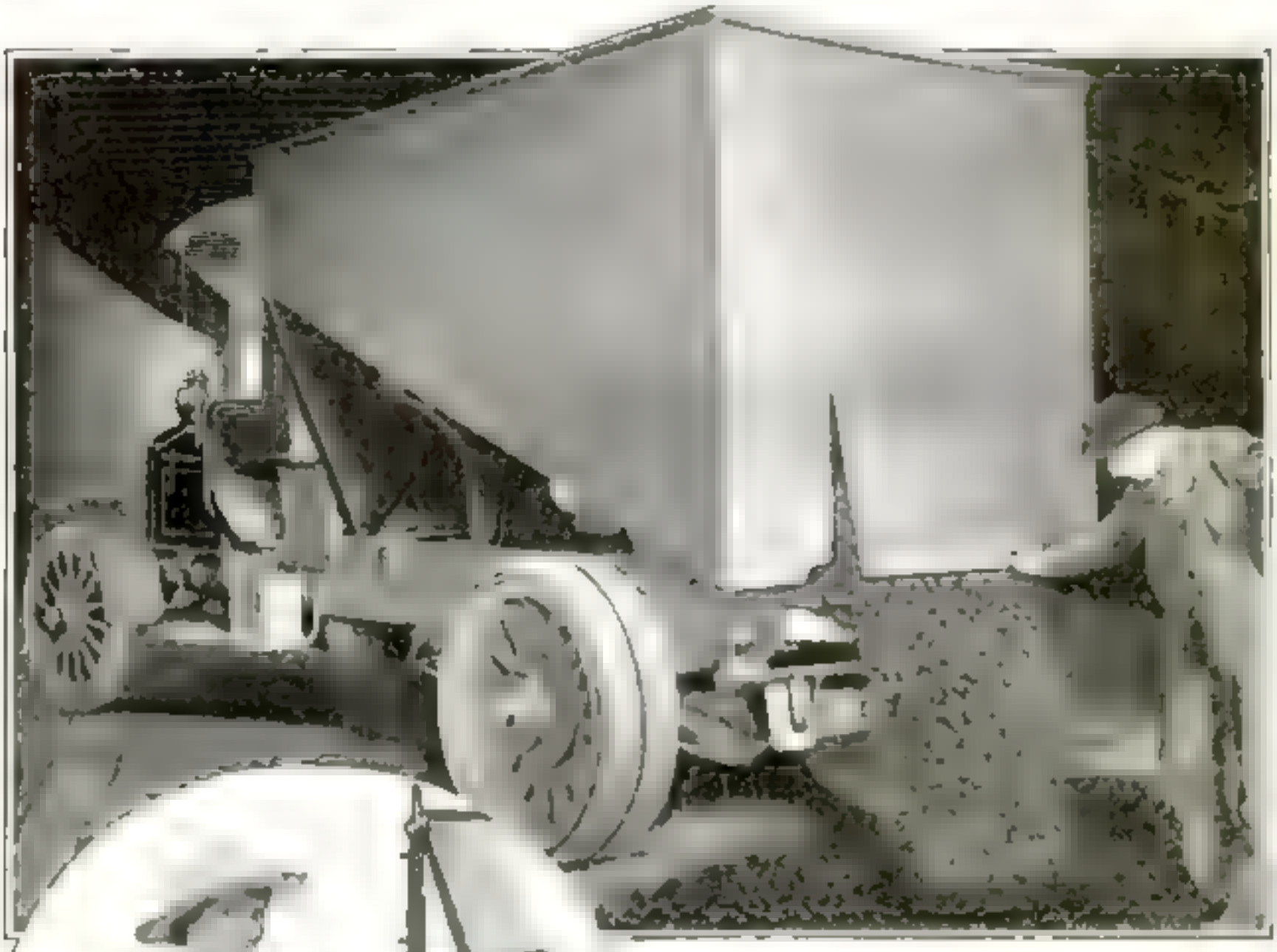
At left: Steering-wheel clock encased in rubber, making it vibration proof, shock proof and dust proof

Above: A [illegible] used as an automobile top holder. It can be adjusted to a sixteenth of an inch and it eliminates projecting arms and unattractive straps

At right: A combination wrought-steel basket and luggage-carrier which slips over the hood. It is rigidly fastened to the frame and to the dashboard

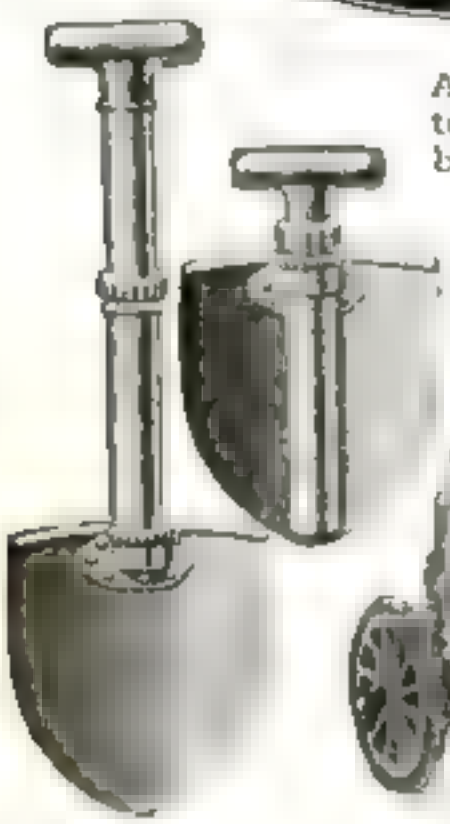
Automobile racks eliminate the greasy service pit. When on the rack the running board is held six feet from the floor

Salt These Days? Here Is the Answer in Pictures

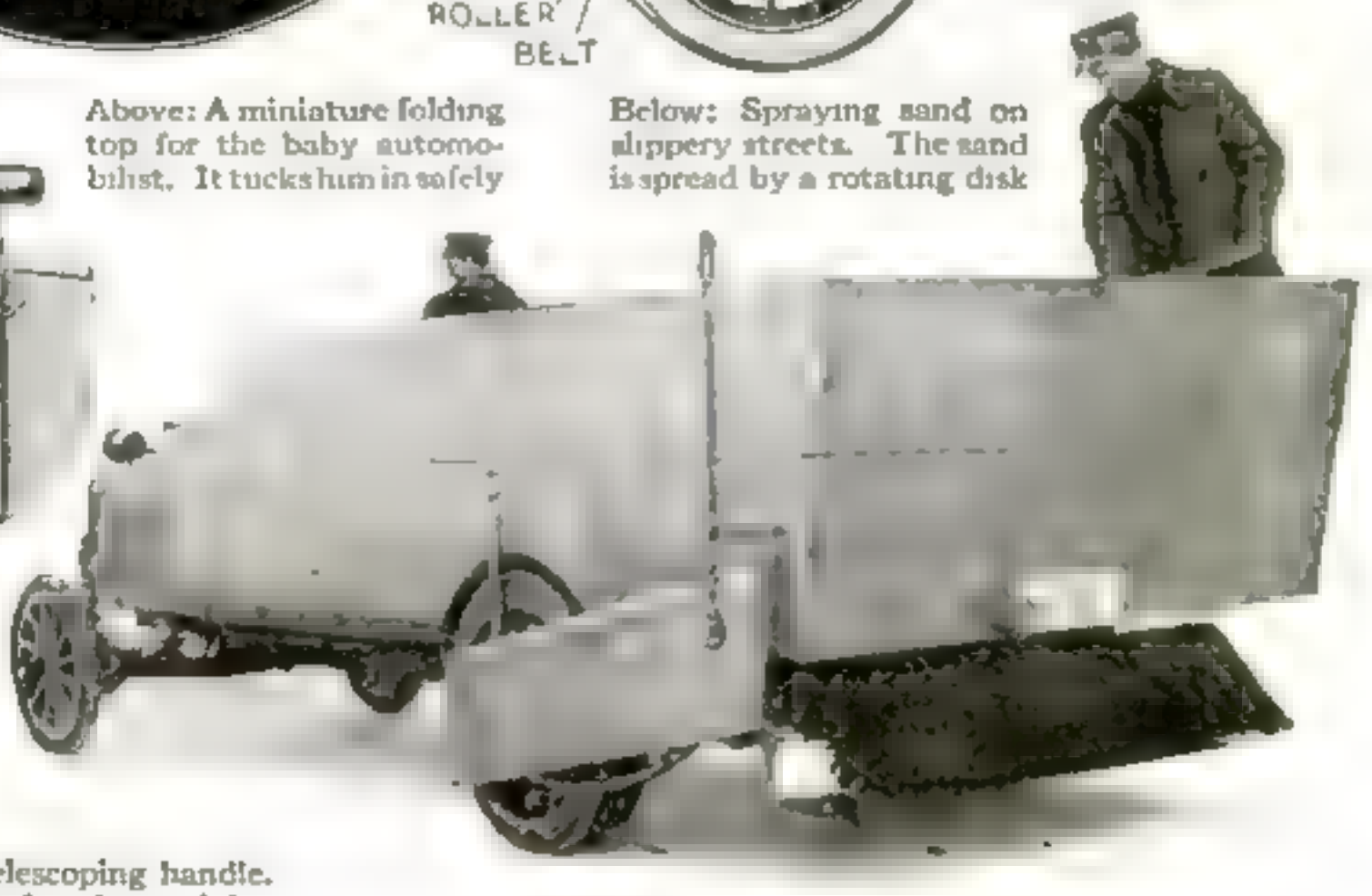


A slanting floor and small rear door enables a motor truck to drop coal into ferry boat bunkers

At left: A non-skid belt replaces the tire [illegible] It [illegible] and travels over a roller on the running board



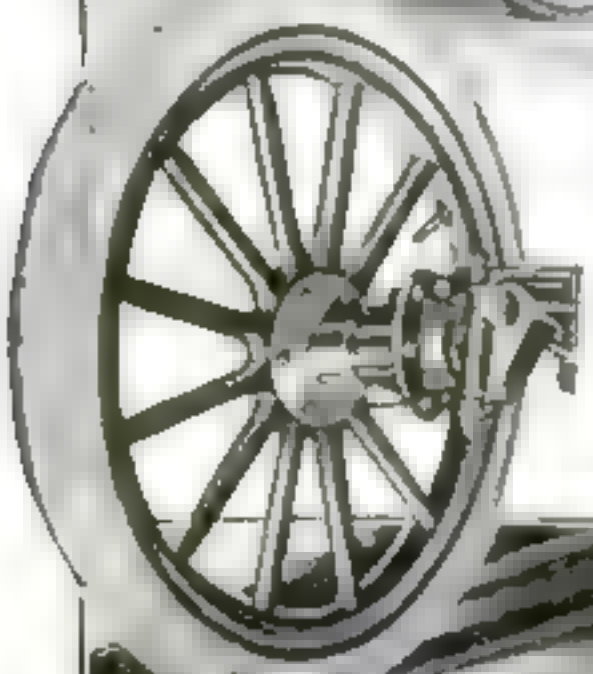
Above: A miniature folding top for the baby automobilist. It tucks him in safely



Below: Spraying sand on slippery streets. The sand is spread by a rotating disk

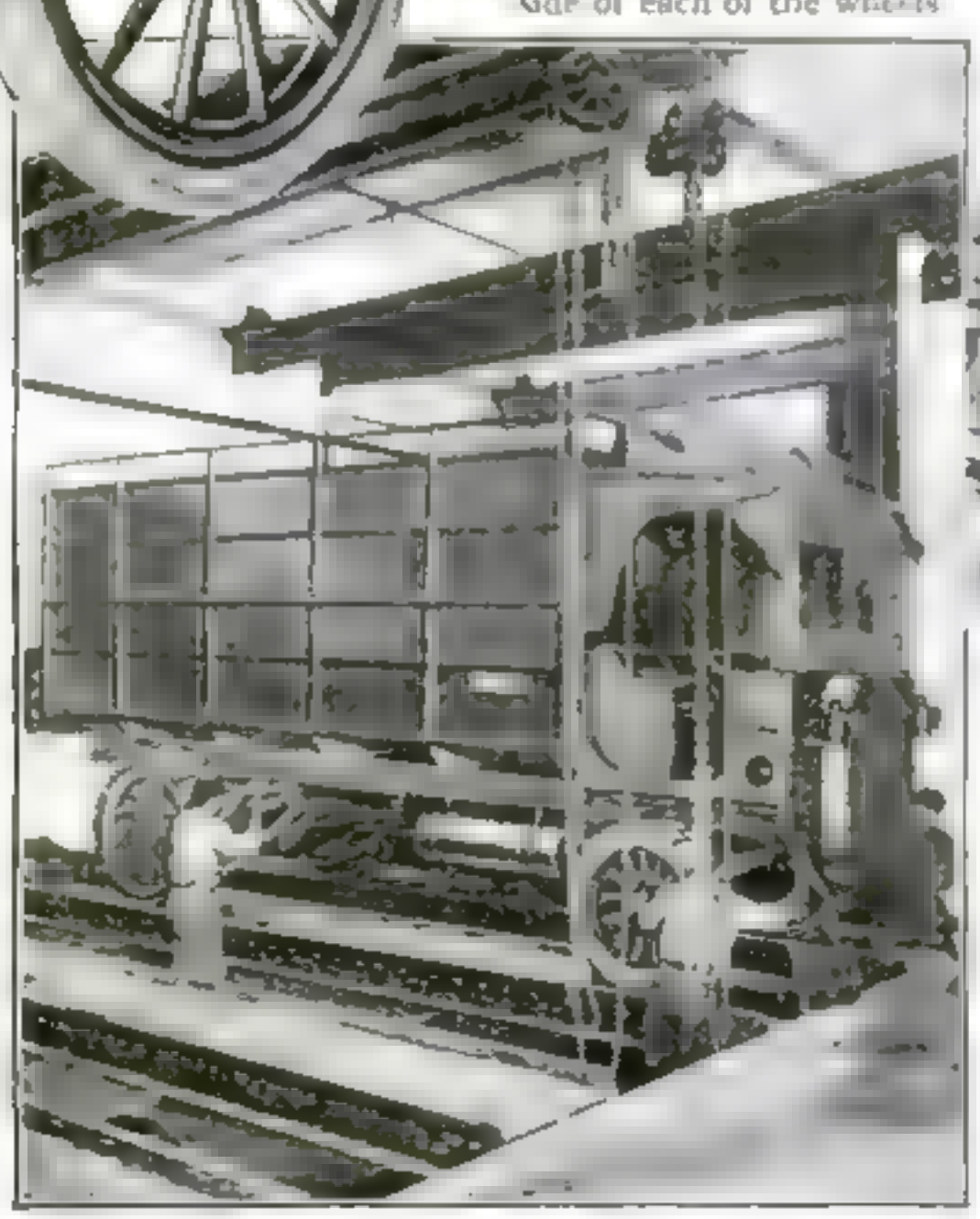
A shovel with a telescoping handle. It is small enough for the tool kit

Above: Twelve-ton trees are carried on truck and trailer in Washington. One truck can move about forty-two thousand feet of lumber a day



At left: A demountable wheel-set for Ford cars, consisting of special steel plates attached to the inside of each of the wheels

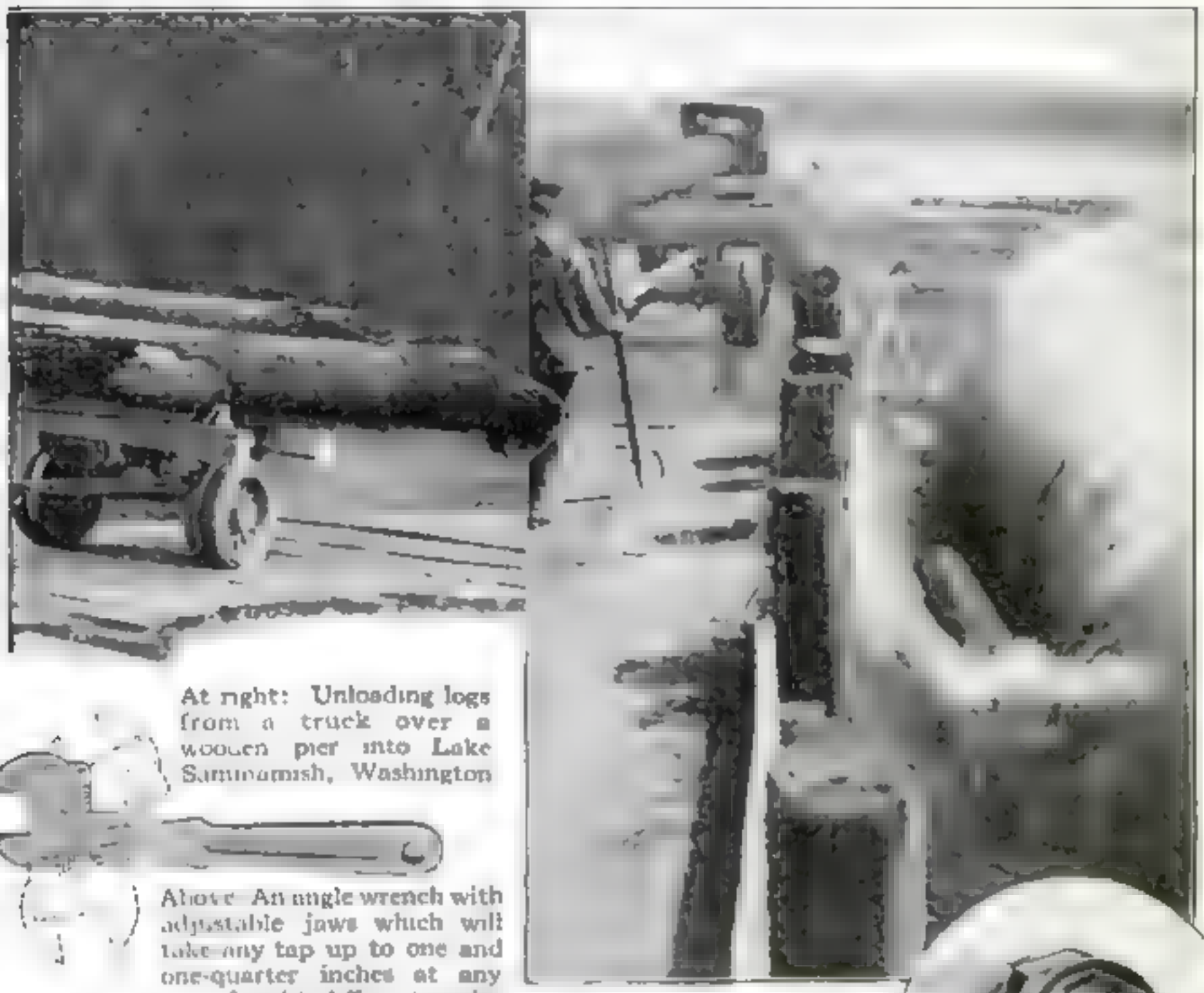
Above: A tool used to remove and replace tires and rims



Above. A sidecar hood and windshield made of transparent material A speaking trumpet facilitates communication with the driver of the car

At left: A sunken floor enables workmen to disconnect motor-trucks and fit or repair the springs while standing upright. Heavy steel bridges support the trucks

Truck Which Are Making Them More Versatile

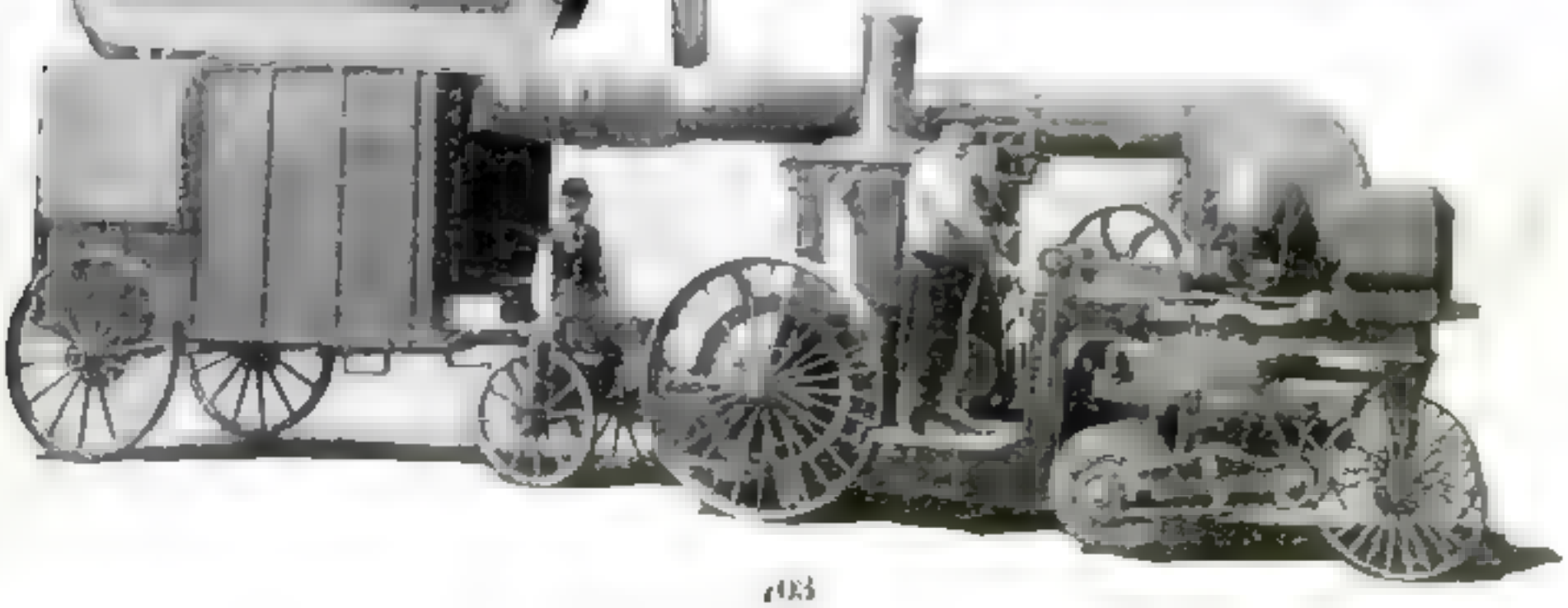


At right: Unloading logs from a truck over a wooden pier into Lake Sammamish, Washington

Above: An angle wrench with adjustable jaws which will take any tap up to one and one-quarter inches at any one of eight different angles

A spark-plug with a turbine fan rotated by the engine explosions Hot sparks are delivered to the bushing, giving a larger sparking area and throwing off waste oil deposits

A gas-electric suction street-sweeper. The dirt is picked up by a revolving brush and sucked into a pipe where a blower sends it to the trailer. There it is screened and packed for removal



Patroling Eight Miles of Fence

How hunters and hounds protected a flock of sheep and how a new type of fence was built to keep out coyotes

TO prevent wolves, coyotes, and other wild animals from entering a pasture where experiments in sheep-raising were being conducted, hunters employed by the Forest Service were required to patrol eight miles of fence twice a day in the Wallowa National Forest, in Oregon.

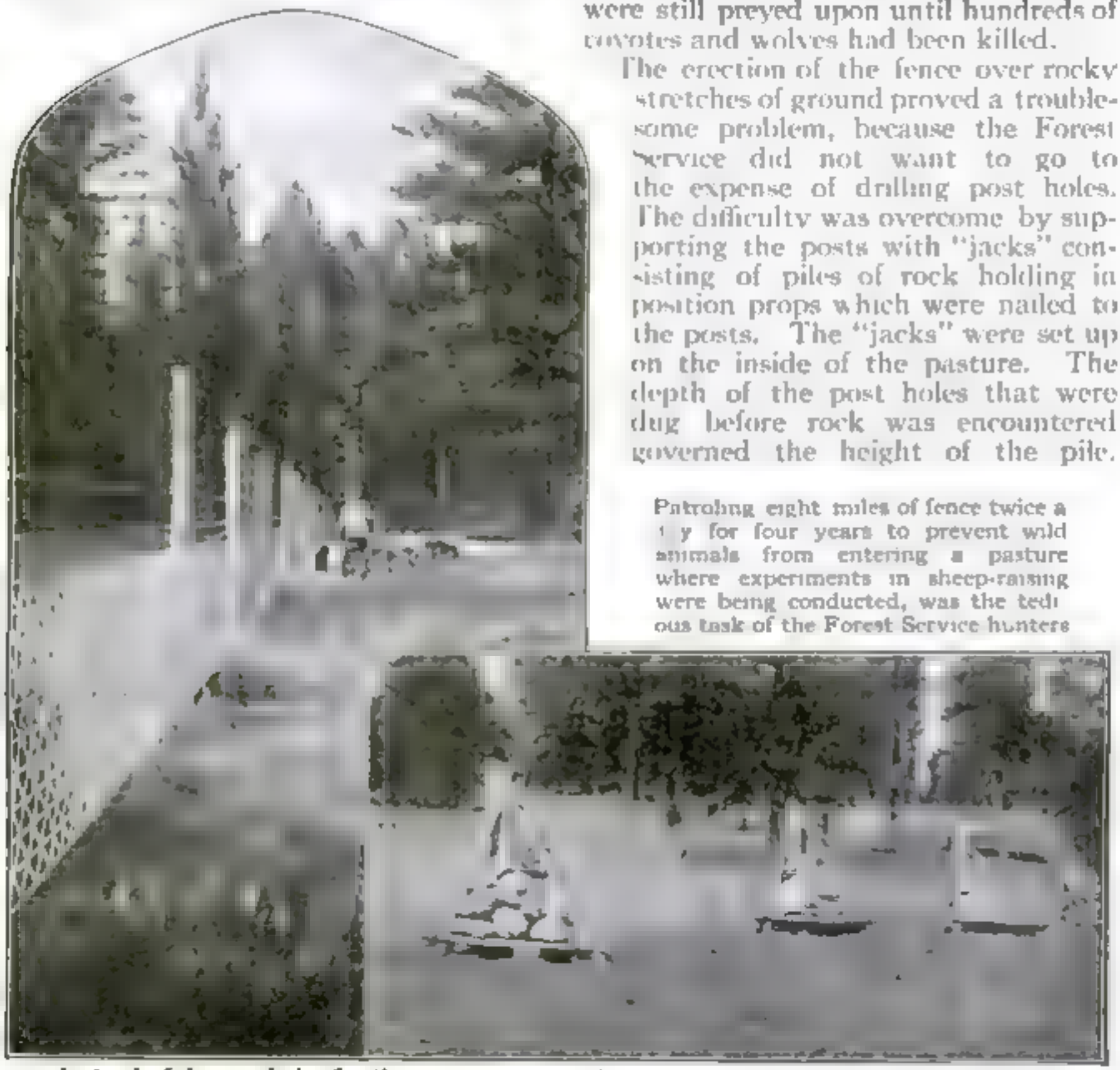
Two thousand five hundred and sixty acres of choice land were enclosed to conduct experiments with a view to ascertaining whether it was more advantageous to care for sheep in pastures than to herd them on the open range. A coyote-proof fence eight miles in length enclosed the pasture. It was made of woven wire about four feet high, with two strands of barbed wire across the top.

The large flock of sheep within the enclosure attracted many wild animals and it was not long before they burrowed under the fence and set upon their prey.

Accordingly, the Forest Service had experienced hunters accompanied by hounds patrol the entire length of fence twice a day for four years. But the sheep were still preyed upon until hundreds of coyotes and wolves had been killed.

The erection of the fence over rocky stretches of ground proved a troublesome problem, because the Forest Service did not want to go to the expense of drilling post holes. The difficulty was overcome by supporting the posts with "jacks" consisting of piles of rock holding in position props which were nailed to the posts. The "jacks" were set up on the inside of the pasture. The depth of the post holes that were dug before rock was encountered governed the height of the pile.

Patroling eight miles of fence twice a day for four years to prevent wild animals from entering a pasture where experiments in sheep-raising were being conducted, was the tedious task of the Forest Service hunters



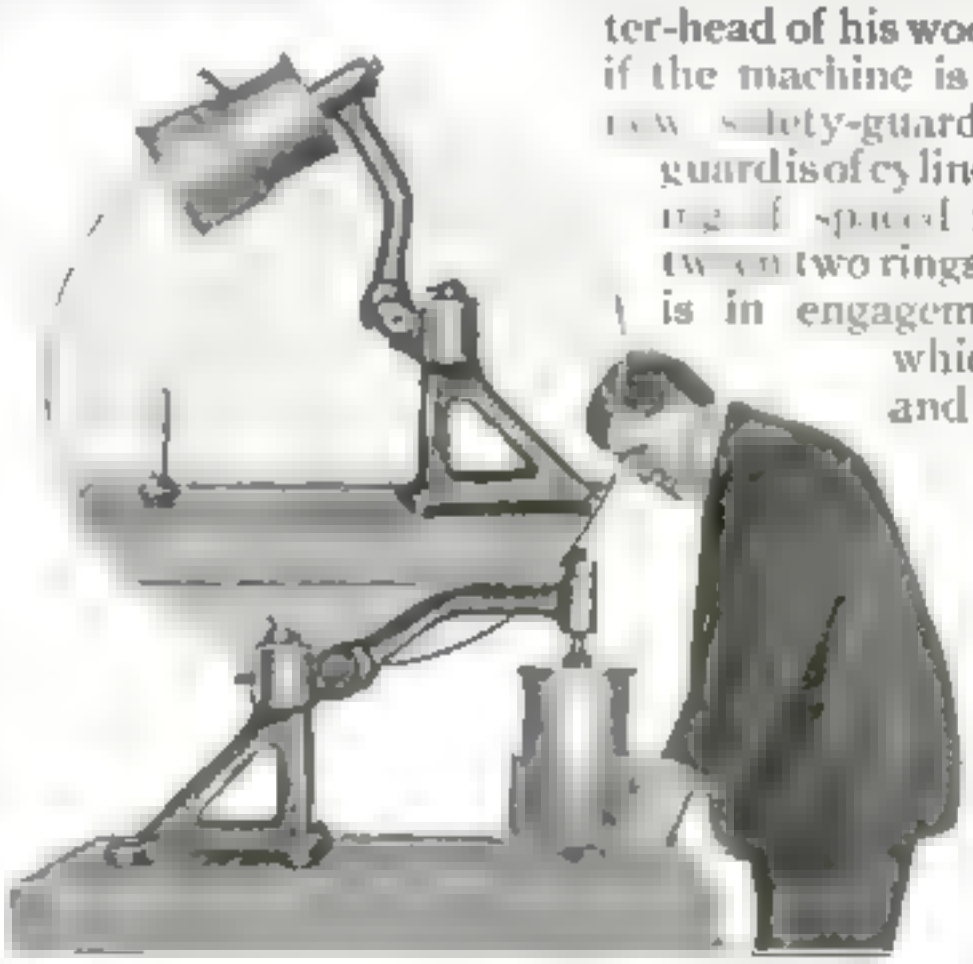
Instead of digging holes for the posts over stretches of rocky ground, where the expense of drilling would have been greater than the Forest Service was willing to incur, large stones were piled up to hold in position props to which the posts supporting the wire were nailed

The spectacle of this one thousand-ton Exposition building floating serenely down San Francisco Bay caused residents of the Coast to doubt the testimony of their own eyes

"Bon Voyage" to the Ohio State Building!

THAT all of the splendid architectural masterpieces which made of the Panama Exposition grounds a veritable fairyland were not doomed to inglorious destruction after their short span of life is evidenced by our photograph, in which the Ohio State Building is seen taking a leisurely and dignified trip down San Francisco Bay.

The building, which weighs more than a thousand tons and which was a conspicuous feature of the Exposition, was purchased by a Country Club patronized by the elite society of San Carlos, California. Arrangements for its transportation down the bay began with the hiring of a number of barges which were lashed together to form a raft on which the building was mounted. It was towed by tugs to San Carlos, a distance of twenty-three miles.



The guard consists of a cylinder suspended from the end of an arm connected with a stationary supporting standard

To Protect the Fingers of the Woodworker

THERE is probably no badge which designates the woodworker or cabinetmaker so surely as the mutilated fingers which most of them carry. So intent does the worker become on the task of getting and keeping his accurate measurements for the cutting process that the danger to his fingers is forgotten until too late. But the fingers of the woodworker cannot come into accidental contact with the blade of the vertical cutter-head of his woodworking machine if the machine is equipped with the new safety-guard illustrated. This guard is of cylindrical form, consisting of spaced rods extending between two rings, the upper of which is in engagement with a sleeve which is telescopically and adjustably mounted on a cylinder. The cylinder is suspended from the free end of an arm which is connected with a supporting standard. This construction admits of raising the protecting cage or guard and adjusting the cutter-blades.

Protecting the Telephone Operator

How the loud-speaking telephone eliminates danger from high-tension currents

The apparatus reproduces the exact tones of the speaker's voice but with magnified volume and clearness, so that a whisper would be distinctly audible under ordinary conditions

ELECTRIC traction and power companies usually have their telephone lines on the same poles with high-tension feeder and transmitter-conductors. As a result, telephone users may be exposed to danger. The high-tension lines may cross or touch telephone lines, or the induced current in the telephone lines, due to their being parallel to the high-tension line, may be sufficiently great to place the telephone operator in imminent danger.

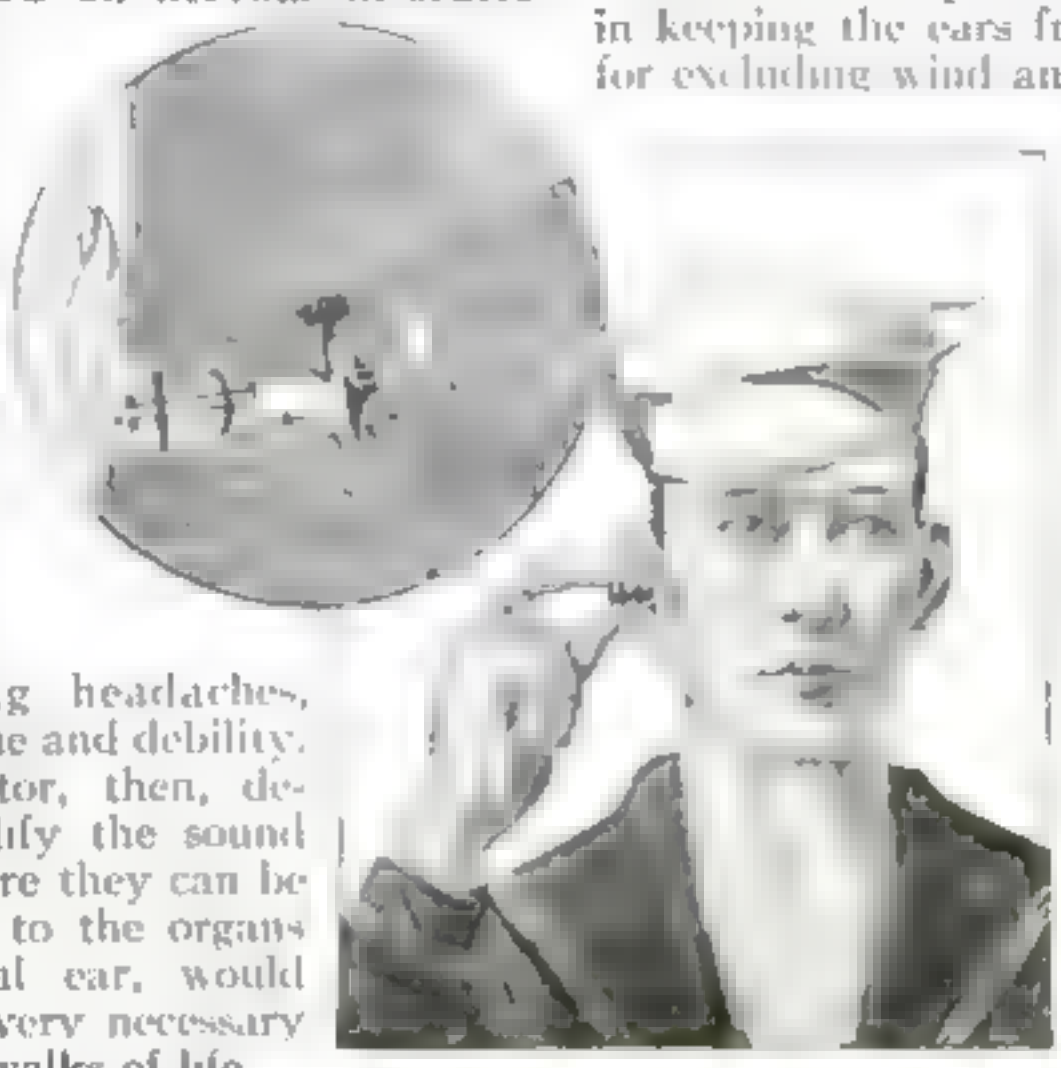
For providing the required protection under the above conditions, the loud-speaking telephone has been invented. The person using the telephone does not come in actual contact with it.

The apparatus illustrated reproduces the voice as spoken into the transmitter with a volume somewhat greater than the speaker's and with perfect clearness. If under ordinary conditions a conversation in a room fifteen feet square can be understood, the speaker would not raise his voice above the usual pitch. In operating the apparatus the conversational tone is reproduced with about the same volume and clearness. The speaker's natural voice is said to be easier to recognize than in the usual type of telephone.

Instead of lifting the receiver off the hook, the method adopted with the ordinary telephone, the operator presses a lever with his foot to call "central."

Protecting the Ears from the Shock of Great Guns

SPECIALISTS on nervous di-orders tell us that the noises of concussions, trains, fog horns, gun reports, the clash of machinery and other harsh or prolonged sounds wear away the energy of the nervous system, shock by shock, causing headaches, deafness, fatigue and debility. An ear-protector, then, designed to modify the sound vibrations before they can be communicated to the organs of the internal ear, would seem to be a very necessary thing in some walks of life.



The device is a guard, not a stopper, and does not interfere with the circulation of air in the canal of the ear

One which has been placed on the market recently is made of transparent material and has two soft rubber disks. One of these disks is small and thin and fits into the canal of the ear adjusting itself to any size ear. The other disk is larger and thicker and covers the orifice of the canal, preventing the protector from going in too far.

The device is a guard, not a stopper, and does not interfere with the natural circulation of air in the canal of the ear. The atmospheric pressure is kept normal and sounds of moderate force enter the ear without change. Only those sounds which are of sufficient strength or of such character as to produce shock are modified. The protector is also useful in keeping the ears free from dust and for excluding wind and water.

There are several of the ear-protectors and shock absorbers on the market. The demand for them has been increased by the war, so many of the soldiers having been deafened from the noise of explosions and bursting shells. Wherever there is a special demand for any article there are always special efforts to improve on the existing models so that a person may take his choice of almost any number of kinds. The type which has been adopted recently by the British Admiralty for use in the Navy is shown in the photograph at the bottom of the page. The neat little box holds a pair of shock-absorbers and fits into the vest pocket as easily as a pill-box. The principle involved is the same as in the first illustration. There are two sound-stops, one in front and the other in back of a sensitive diaphragm. These effectually prevent any violent shock from passing on to the inner ear. The stops and the diaphragm are held in place by washers. The device can neither go in too far nor drop out of the ears accidentally.

The type of ear-protector which has been adopted by the British Admiralty for use in the Navy

It has been found that soldiers using these ear-protectors are stronger physically and less inclined to suffer from digestive disorders on account of the better condition of the nervous system. Residents of rural districts visiting in one of our modern cities, and even the long-suffering city-dweller accustomed to the noise might also value the shock-absorbers.

Improving the Imperfect Hen

Ingenious man, after considering the hen, reduces her to a mere egg-laying machine

By George Wörts

IF occasional assaults upon the patent office by ingenious, inventive gentlemen from all parts of this country are to be taken seriously, Mother Nature made some silly mistakes when she devised and constructed the *gallus domesticus*, otherwise known as the barnyard fowl.

When Nature provided the hen with two legs, a head, feathers and a mysterious internal mechanism which disgorges an egg on occasion, she left the poor thing with a woefully incomplete equipment for living the barnyard life. In view of Nature's negligence, brains mightier than the hen's now buzz through the long days, conceiving apparatus, mechanisms and "devices"—mostly "devices"—for making the imperfect *gallus domesticus* live a blamelessly chaste and worthwhile existence.

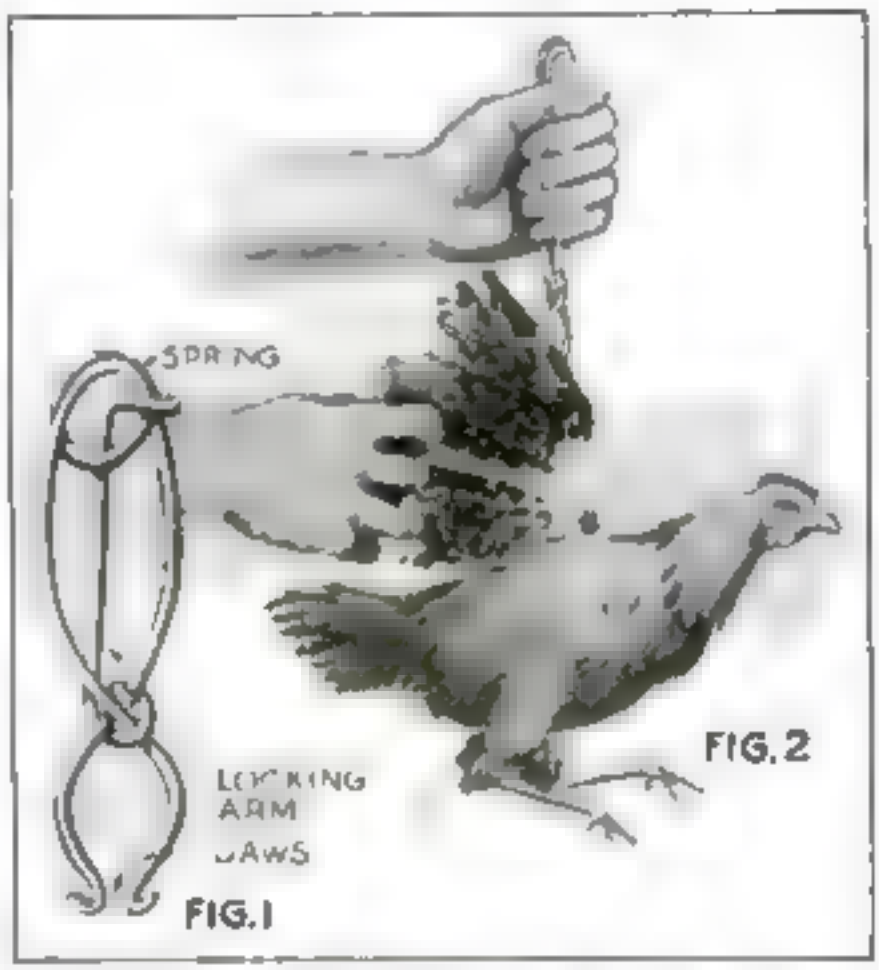


FIG. 1

FIG. 2

A hen handle. With it, the fowl may be effectually powdered. The wing-clip clamps the members securely while the germicide is being applied liberally

If the learned opinions of poultry improvers could be combined into a barnyard creed which the hen could study at her leisure, and if it were printed legibly and tacked up conspicuously within and without the hen roost, then the hen might raise herself in the estimation of those who consider her imperfect. Why not, indeed? The suggestion is offered freely to the entire poultry universe. Why not

An inspection of the rooster's beak will reveal the reason for his apparent penitence. Inventive man has muzzled the rooster. The reason being that he (the rooster) occasionally plucked beakfuls of feathers from the wings of his wives

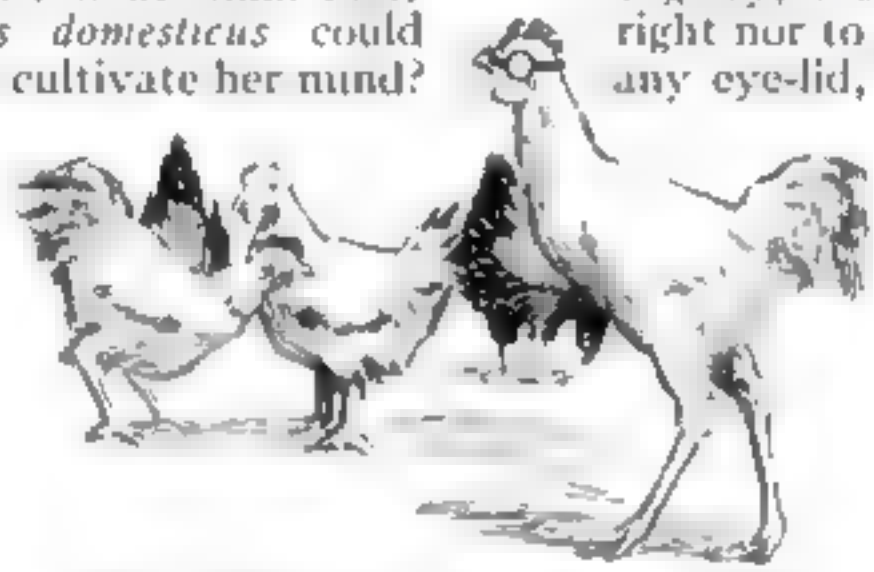
The ghost like figure of a hen seen soaring over the hen house mirrors the thoughts and desires of the hen in the foreground. Her wing is clamped to her side by means of a capable wire clip. She cannot fly, she can only dream of flying

The hen at the left has not been harnessed with the end in view of giving the children a ride. She has submitted to the indignity of a "setting preventer." When she attempts to climb into a nest and settle down, the imagination of the reader can supply her subsequent astonishment and chagrin. Will the rooster at the right scratch up the new garden? Not after he tries it with this leg attachment designed to prevent just that performance

have a creed, or a set of poultry commandments struck off from the press and distributed gratis, or at small cost, so that the *gallus domesticus* could memorize them, and cultivate her mind?

Differences of opinion might arise regarding the necessary content of this creed; but after thoughtful examination of the available material secured from the Patent Office, the following resolutions which encompass all the important points have been drawn up:

"I will not set when my master denies me that pleasure, neither will I fly maliciously out of the confines which my master has provided for me, I will render a correctly audited account of the number of eggs laid by my humble self in the week; and all of these eggs shall bear my personal trademark; I will lie in a posture according to the will of my merciful master, awaiting sacrifice, moving neither head nor tail feather; never will I scratch up the gardens which the Lord seemingly provideth not for me; ever will I tread in the paths wired off for me, bringing forth the young of my species whenever it is demanded of me, and sitting uncomplainingly upon glass eggs, door knobs and other objects which my master kindly provides for me. Yea, verily, I will walk in the cow-paths of glory, looking neither to my right nor to my left, nor winking any eye-lid, thus that my sacred name shall be saved from the unutterable disgrace into which it has been dragged by my unfeathered sisters in the great, ungodly cities."



This rooster is not attending a poultry school, despite the evidence to the contrary, which the goggles create. A thoughtful inventor has simply provided him with a protection for his eyes. It can be seen that the rooster appreciates this courtesy highly. Strangely, the lady hen to the left seems on the point of fainting at sight of her husband's odd appearance

One of the heartiest laughs we have ever wrung from a joke-book was recently unearthed from what is occasionally the greatest of all joke-books—the Patent Office Gazette. The joke in point had to do with an enterprising apparatus devised to prevent the hen ambitious to set from realizing her ambitions. It comprised a dozen eggs all of which were connected together by means of short lengths

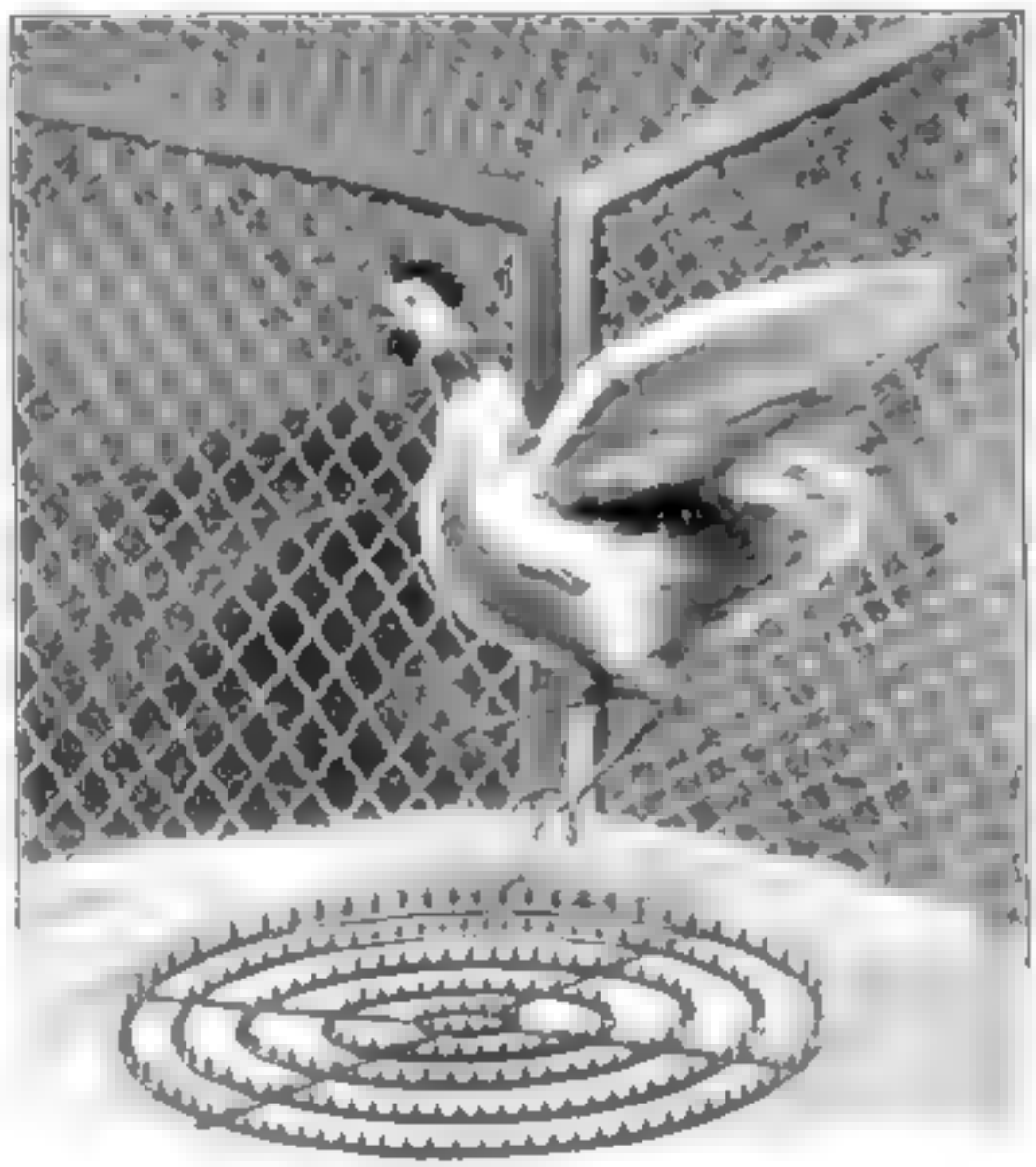
When the chicken is caught its legs are clamped, making it helpless and passive

of rubber tubing through which ice-cold water from a tank suspended from the top of the henhouse was run to the eggs. When the mothering instinct became too great for a hen to resist she would mount these joke-eggs. When her warm breast came in contact with the frigid eggs, she would leap off with a cackle of anguish, and thereafter be cured of the setting habit.

Was it not ingenious? Indeed it was.

A contraption devised for the same purpose and also unearthed from the scintillating pages of the Patent Office Gazette is displayed pictorially in these pages. It has a devilish ingenuity all unto itself Look at this picture in which a hen may be observed leaping angrily from a nest of spikes. This pointed warning to the hen who aches to set, belongs to the same category as the machines brought out for purposes of inflicting slow torture at the time of the Spanish Inquisition. Some prehistoric fragment of barbarism in all of us makes a device of this sort unusually interesting. Unquestionably, if this invention were installed in a barnyard, the farmer-owner could charge ten cents admission, and the public would get a generous ten cents' worth in watching fowl agony. Can you put your own soul through the misery to which the would-be-mother hen, with the delicacy which that feeling is supposed to bring, submits herself when she settles calmly down, with every honorable intention, upon a nest of naked, brutal spikes?

The hen-house-of-horrors, if properly furnished with these machines of malice, would not satisfy itself merely with ice-cold eggs and spiked nests. Other inventions, if they were attached, would transform the peaceful hen into a picturesque spectacle, a cross between a taxicab and an infernal machine. In fact, if the hen were properly equipped with all the "useful devices" which man has thoughtfully and modestly provided, she would not only be bound, gagged, fettered, spiked and frozen; but her vision would be guided by goggles; she would stamp each egg as it was laid with a trade-mark. Altogether she would bear so much mechanical miscellany upon her innocent young shoulders that she could neither sit in the forbidden nest, run amuck in the forbidden garden, fly into the forbidden air, nor, indeed, could she lay the luscious egg, nor hatch the necessary and succulent young springling.



When the would-be-mother hen approaches this nest she is received by an array of sprouting spikes. The man who conceived the idea probably derived it from a volume upon the Spanish Inquisition. It is indeed most effective. The hen squats upon the spurs; and she arises with cackles of wrath, cured of her desire to set

Human sympathy with the helpless unfortunates would prompt one to say, "Let the poor creatures alone!" Nevertheless, the farmer may see in the numerous inventions mentioned helpful means of augmenting and protecting his egg supply, and if so, humanitarians have no right to hinder him from employing them.

Telegraphing Through the Ocean

So that ships may avoid one another in a fog, Christian Berger converts them into huge violins which send out sound-wave signals

THE small-town American boy has a noise-making toy, which for simplicity, cheapness, and, above all, effectiveness, can hardly be surpassed. The principal components of the contrivance are: one tomato-can, one string, one lump of resin, and plenty of muscle in the small boy's right forearm.

Into a hole in the bottom of the tomato-can the string is run, a lumpy knot on its inner end preventing it from slipping completely through. This leaves a long, dangling cord when the ex-tomato-container is held outward in the boy's left hand. With his right he grasps the lump of resin and commences to stroke the string.

The harder he pulls the more distracting the noise

A responsive "ee-ee-eek" emerges from the mouth of the can at the beginning of the stroking process. Shrieks, cat-calls and strident, earsplitting wails can be made to follow the "ee-ee-eek."

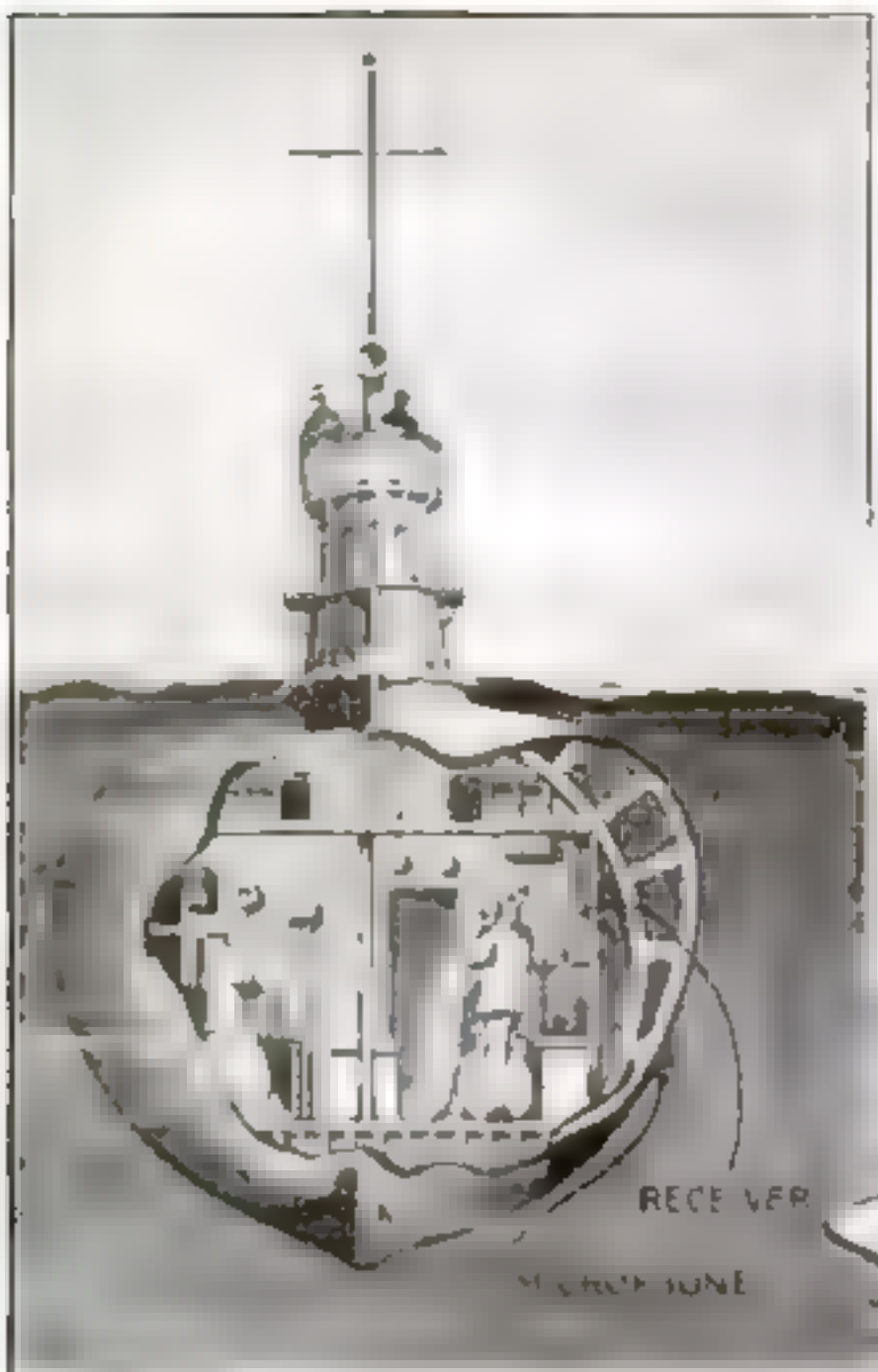
In a sense the contrivance is not unlike a violin. The can is a resonator; so is the violin body. The string is rubbed to make a sound; so is the catgut of a violin. The fundamental principle involved is the same.

Curiously enough, a contrivance operating very much on the same principle has been found to be one of the most effective submarine signaling devices yet brought out. The machine in question is the invention of Mr. H. Christian Berger, a New York physicist. It has been put in successful service on a number of American vessels, some of them warships—despite its resemblance in principle to the tomato-can toy or the violin. It is the result that counts.

Mr. Berger's device employs either a narrow steel strip or else a piano wire as the vibrating member, this serving the same purpose as the string in the case of the can-toy or violin. One end of the wire is attached to a plate in the steel hull of a vessel, the other end being fastened to a similar plate on the opposite side, or else terminating in a framework affixed to a convenient beam. The steel plate in the side of the vessel acts as a sounding-board to send sound-waves out into the water, just as the bottom of the tin can sends waves into the air. Instead of a lump of resin in the hands of a small boy as the exciting agency for the vibrating strip, this contrivance employs a motor-driven rubbing-wheel, the felt-covered rim of which is the equivalent of a violin bow and is moistened with alcohol in order to provide an efficient rubbing medium. Although the motor which drives this wheel runs continuously, the wheel itself may be started and stopped at will by means of a telegraph-key controlling an electromagnetic clutch mounted on the motor-shaft. Thus a telegraph-key governs the sending of vibrations just as in wireless telegraphy.

In a few feet under water a bell's sound loses its characteristic bell like tone

The question naturally arises: Of what use is a submarine signaling

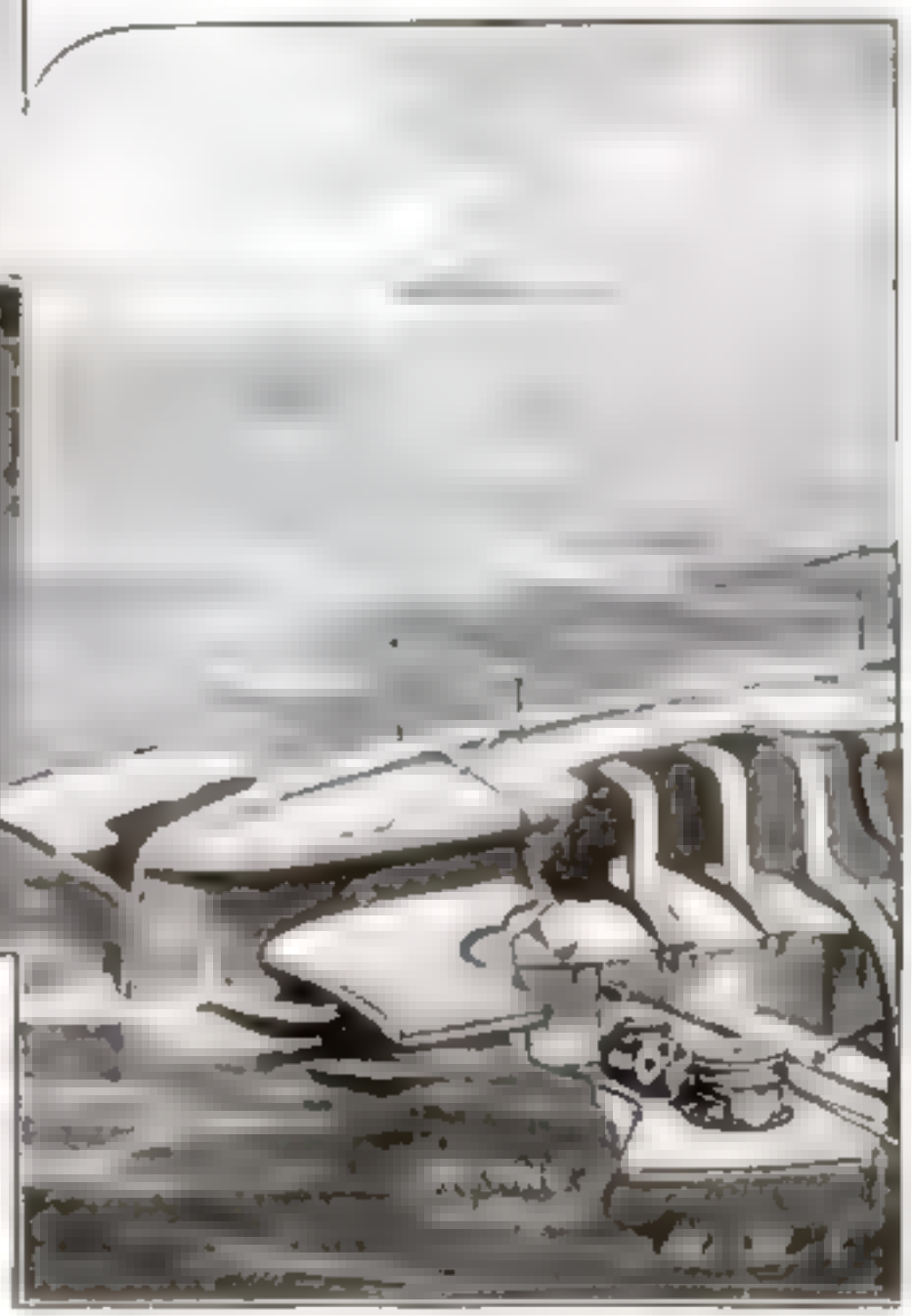


The signals sent out under the water are picked up by a microphone in the vessel

device. Is it not enough that men can signal through air with whistles and lights, through ether with wireless telegraphy, and over wires with the aid of electricity?

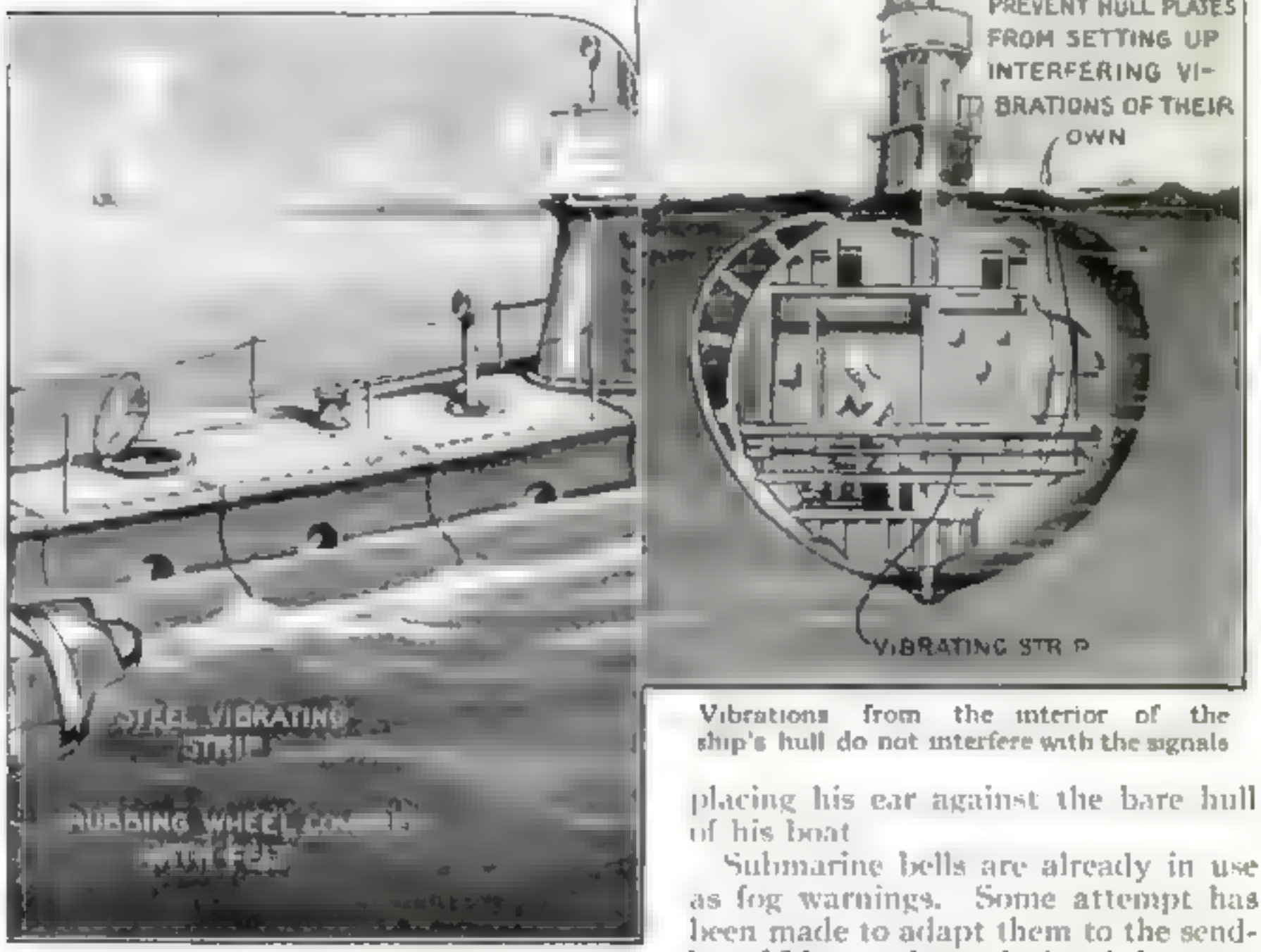
The answer is this: Strong as men have built ships, as well as they have chartered the ocean, as many safety devices as they have installed on boats, one overpowering danger still confronts navigators. That danger is fog. In a thick fog it is almost impossible to see from one end of a boat to the other, let alone out over the water toward any approaching vessels. Sound-signals do not carry far in air and are most untrustworthy. Hence the frequent mishaps which occur when bell-buoys, or other sound warnings near hidden reefs are not heard. Signal lights, rockets, lanterns, and similar devices depending upon light are obviously inoperative in a fog. Wireless waves—usually so effective in warnings of sea dangers—have their limitations, too. Unless the operators carry on specific conversation as to their ships' positions and the danger of bumping into each other or into objects on shore, the wireless signals themselves carry no warning of impending disasters; the strength of wireless signals, as received, is no criterion of the sending vessel's distance.

Mr. Berger's device resembles in principle the tomato-can toy. On the other hand, sounds sent out into the water



Hence when a fog descends over the sea, light signals are utterly useless, sound signals in air do not carry far and are uncertain, and wireless telegraphy is good only in certain instances. Is it any wonder that inventors have taken to investigating the possibilities of submarine signaling, all the more since they have discovered that sound-signals will carry long distances under water and are unaffected by fogs and storms?

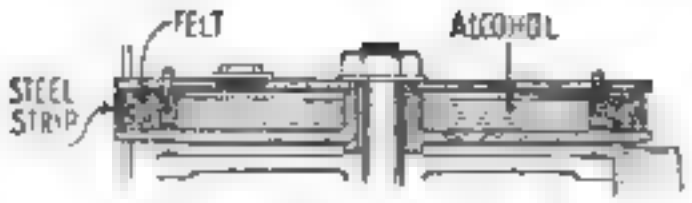
by it can be made to have any sustained duration desired, so long as the felt-rimmed wheel rubs on the steel strip



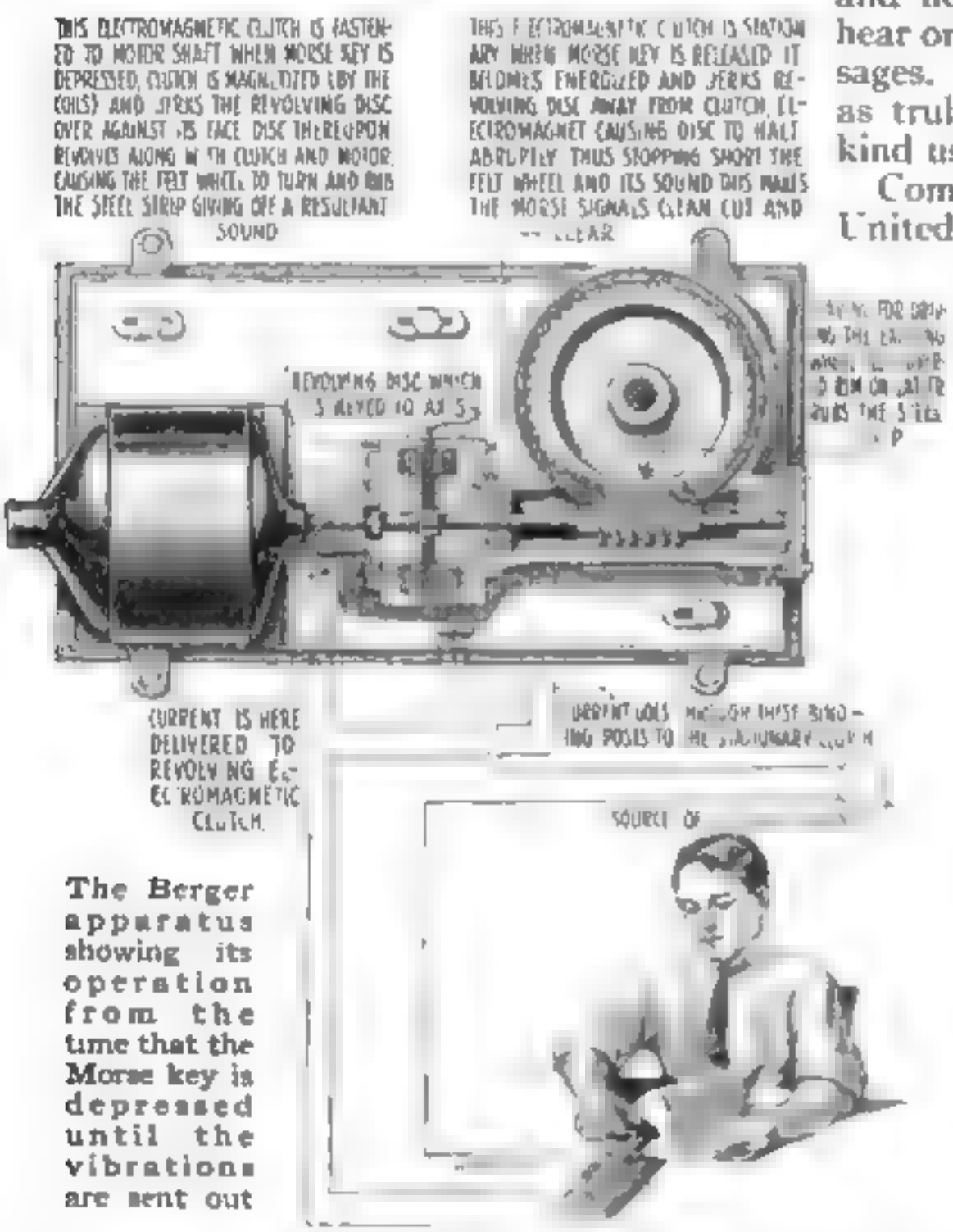
Vibrations from the interior of the ship's hull do not interfere with the signals

It is a queer world, this—down "under the sea." It might be supposed that no sounds at all can be heard under water. The opposite is true. Sounds carry better in a dense medium like water than in a comparatively "thin" gas such as air. All sorts of sounds can be heard under water—the throb of some distant ship's propeller, the pounding of engines, the explosion of distant mines, and hundreds of other noises. A microphone, placed in a chamber of water at the side of the receiving vessel and connected with a telephone receiver, aids in this hearing. Singhalese fishermen, however, have for centuries carried on communication between boats by the simple method of striking an earthen bowl under water, the listening fisherman placing his ear against the bare hull of his boat

Submarine bells are already in use as fog warnings. Some attempt has been made to adapt them to the sending of Morse telegraph signals between one boat and another, as for instance between a warship and a submarine. The sound from submarine bells, however, does not endure; it is not sustained. In other words, one stroke on a bell sounds to the underwater listener just like any other stroke. All the strokes are short—have no duration. Since all the sounds are "dots," it is obviously impossible to send Morse signals, dependent on both dots and dashes (short and long sounds). Moreover, seamen who have listened to these underwater bells say that in a few feet a bell's sound loses its characteristic bell-like tone. The sound simply comes to the ears of the listener as a dull, leaden "click," something like that produced when two ordinary tablespoons or a knife and fork are struck



SECTION OF FELT-COVERED WHEEL



The Berger apparatus showing its operation from the time that the Morse key is depressed until the vibrations are sent out together. Since all sounds come to the listener alike, it is obviously impossible sometimes for him to tell whether he is listening to a bell or to some strange noise of the sea.

Mr. Berger's submarine signaling device, however, has the one great advantage that sounds sent out into the water can be made to have any duration desired. As long as the felt-rimmed wheel keeps rubbing on the steel strip, a steady, sustained note is sent outward. As is explained in the illustration above, the rubbing of the wheel against the strip is under control of a telegraph-key, the sender operating this just as he would one on an ordinary electric telegraph circuit. As the first illustration on page 712 makes clear, these signals sent out into the water are picked up by a microphone (delicate form of telephone transmitter) mounted in a water-filled chamber in the side of the receiving vessel. The listener simply adjusts telephone-receivers to his ears and hears signals just as he would hear ordinary wireless telegraph messages. This sound-wave telegraph is as truly a wireless telegraph as the kind using electric waves.

Commander F. L. Sawyer, of the United States Navy, has proposed that the Berger invention be combined with ordinary wireless telegraphy, the two together forming an effective means of warning in case of fog. The fact that electric waves travel with the speed of light (186,000 miles per second), or almost instantaneously, and that sound waves in water travel much more slowly (4,708 feet per second), is the basis for the proposed method. The electric signals and the sound-signals are sent out simultaneously by the approaching vessels. The listener on either boat hears the wireless signal instantly and the sound-signal a few seconds later (it having taken that long to arrive) and he can judge fairly well how far apart the two vessels are—the number of seconds in this interval multiplied by the speed of sound in water giving the approximate distance. If the time intervening between receiving the two signals grows less and less the operators know that the two vessels are approaching and may collide. A code system, composed of different letters of the alphabet and indicating whatever course the vessels are pursuing, is also proposed.

Professor R. A. Fessenden has invented an underwater sound-signaling machine somewhat like Mr. Berger's. His contrivance, however, makes use of an electromagnetic oscillator working on one of the plates of a vessel's hull in place of Berger's vibrating wire. Both contrivances are effective means of communicating with submerged submarines.

One of these steam-operated sawing machines attended by a gang of four men will perform more work in an eight-hour day than thirty woodmen

Combined Velocipede and Hobby-Horse

A RECENTLY invented figure toy devised by Daniel Markmann, of St. Louis, Mo., combines the velocipede with a hobby-horse. The legs of the horse are pivotally attached to the body and have projecting pieces positioned to engage arms on a sprocket-wheel within the body of the horse.

By this means, movement of the legs is obtained and a life-like appearance that is pleasing to youngsters generally, is given the toy. The chain which operates the rear wheels is connected through the supporting hollow post to another chain geared to the velocipede.

Within the hobby-horse is a sprocket connected with the wheels through mechanism in the central pillar.

The legs of the horse swing backward and forward, giving the impression of a prancing steed to the youthful owner, while he is getting the same amount of exercise with his pleasure that he would on the ordinary velocipede.

The toy is light in weight and easy-running, and the bridle is adjustable.

Within the hobby-horse is a sprocket connected with the wheels through mechanism in the central pilar

Felling Trees Economically with a Mechanical Swordfish

THE growing demand for lumber in England and the shortage of labor has resulted in the invention of a tree-felling machine which is said to perform more work in an eight-hour day than thirty woodmen. A feature of the machine is the cleanness of the cut and the closeness to the ground at which the saw works, leaving no trunks standing and thus preventing waste.

The machine is mounted on removable wheels for transporting it from place to place. It consists of a steam cylinder fifteen inches in diameter with a piston-rod having a nineteen-inch stroke. It is attached to a light wrought-iron frame of triangular shape, so that the saw can be fed up to its work by means of a hand-wheel worm.

The saw is fixed to the end of the piston-rod and the teeth are designed to cut on the inward stroke only. The blade slides between guides, and there is no possibility of buckling. The boiler is heated by refuse wood picked up wherever the machine may be used.

It is especially advantageous for clearing timber from land destined to be used for buildings, parks or roadways, where an even surface is essential.

A Daylight Developing-Tank

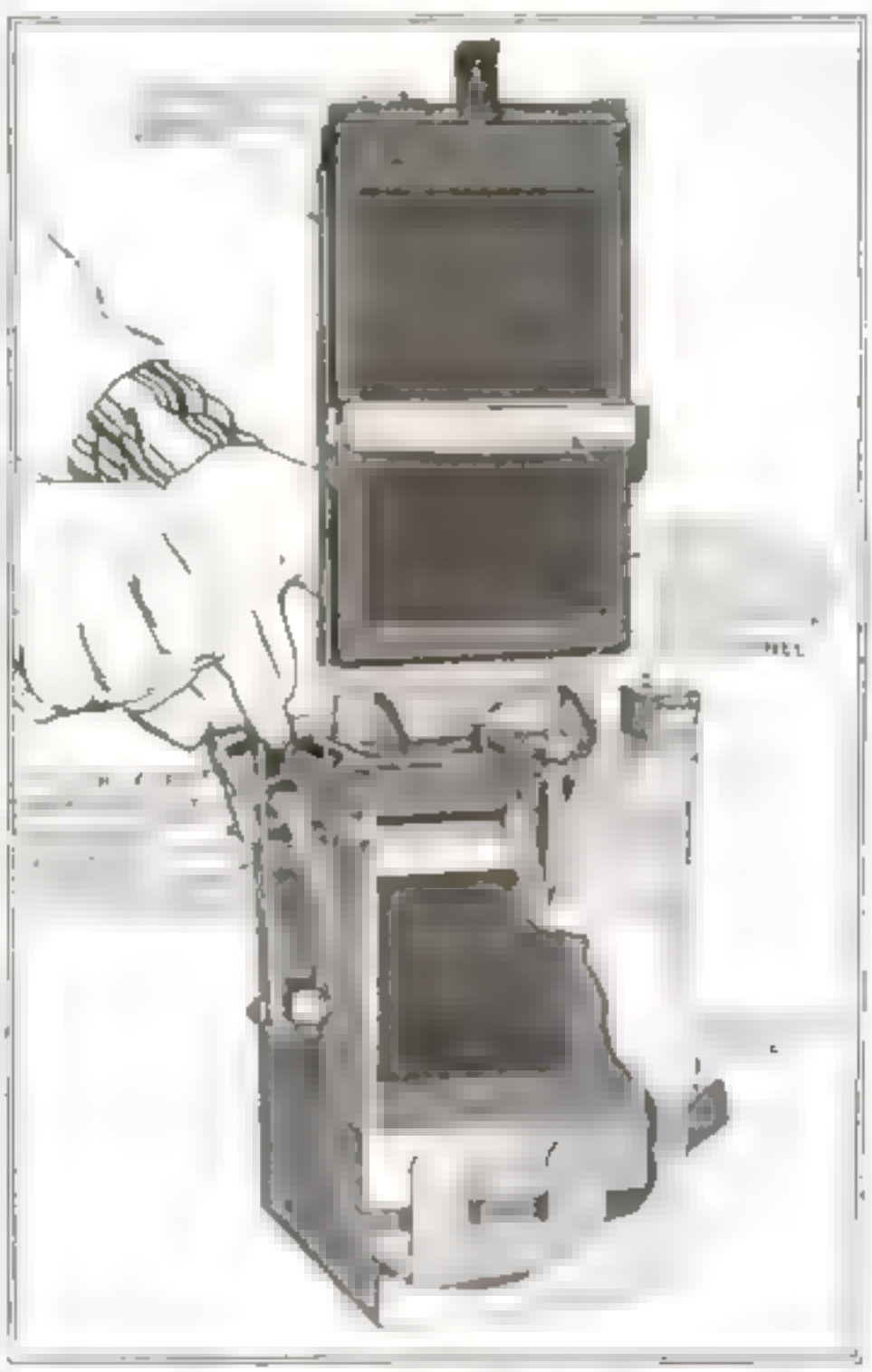
An ingenious apparatus which enables the photographer to develop his photographic plates in daylight

ALL outdoors is the vast laboratory of the camera enthusiast when he is taking pictures; but when he develops them he has to confine himself to a stuffy, insanitary darkroom and there work as best he can with acids, despite the developing tanks on the market.

Had Colonel Roosevelt a suitable and convenient means for developing on native soil his pictures of the River of Doubt they might have been saved. As it was, a large and valuable collection of photographic plates was lost when the supply boat carrying them was capsized. The plates were recovered but immersion had ruined them.

Misfortune of a somewhat similar nature attended the exploration party headed by Carl Akeley, the hunter and naturalist, on one of his trips into Darkest Africa. The climate of Africa is particularly severe on photographic materials. Mr. Akeley had taken a large number of animal and native pictures but he was wounded by a charging elephant. When he arrived at the first place where he could have his plates developed (he had intended to reach this place fully sixteen months earlier) he discovered that his pictures were worthless.

To provide the photographer with an apparatus which will make it possible for him to develop his plates as soon as he desires, and to enable him, at the same time, to work independently of the darkroom, Raymond A. Woodman, of Mitchell, South Dakota, has invented a developing tank by means of which plates may be loaded as well as developed in daylight.



The daylight developing tank ready to receive its first plate. At the top is shown the transferring-hopper with the plate-holder held securely in place by the lock-bar. The tank proper consists of a handle and a quadrant with twelve points representing the twelve interior compartments for plates; a handle on a slide to open the admitting slot just long enough for the plate to pass through; a funnel through which the developer is poured, and a waste-valve drainage

In brief, the apparatus consists of a transferring-hopper which is nothing more than a receptacle for transferring the plates to the developing tank; a lock-bar which locks the plate-holder of the camera securely to the hopper; a locking-dog, which, when released, enables the hopper to enter the tank with the plate, and a handle and quadrant with twelve points representing the twelve compartments for plates in the tank.

When using

Mr. Woodman's apparatus the first operation consists in placing the handle of the developing tank on the first position of the quadrant, on line marked I. This insures the insertion of the first plate in compartment I of the tank. The plate-holder of the camera is then removed from the camera box and placed in the transferring-hopper for its entrance into the tank. After it has been securely fastened to the hopper by the operation of a lock-bar, the slide on the holder is withdrawn without exposing the plate.

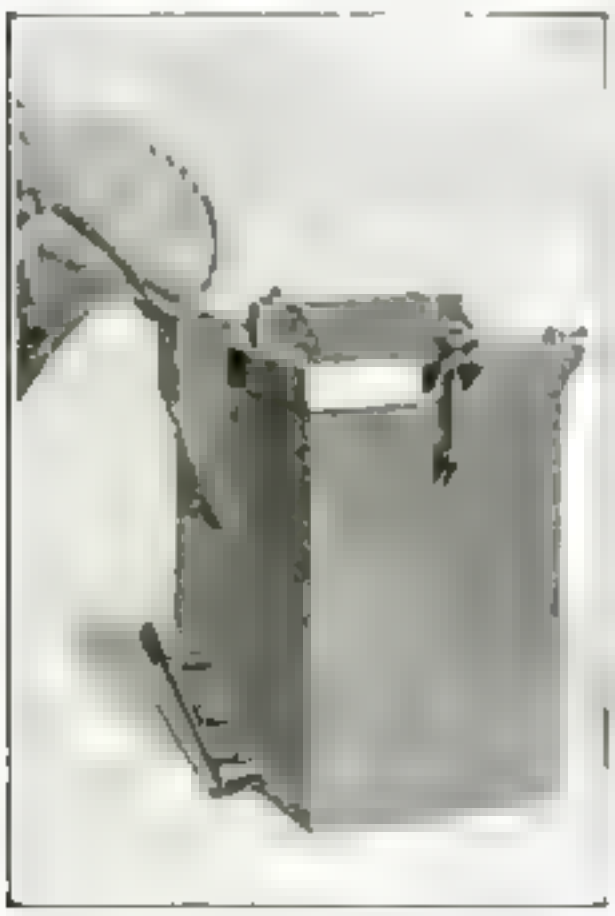
Because the transferring hopper is lined with black felt, making a light-tight joint with the holder, the plate is protected from the light while it is being passed from the holder to the hopper.

Next, the plate is projected into the tank. This is done by releasing the locking-dog attachment and pulling back the handle, which opens the admitting slot and closes it automatically as the handle is released. This protects the plates in the tank while the plate-holder is being changed.

The handle on the hopper is then advanced to the second line on the quadrant, the plate-holder is reversed, and another plate inserted. The operations are repeated until the tank is loaded. At this point the transferring-hopper is pulled out of the slot in the tank cover.

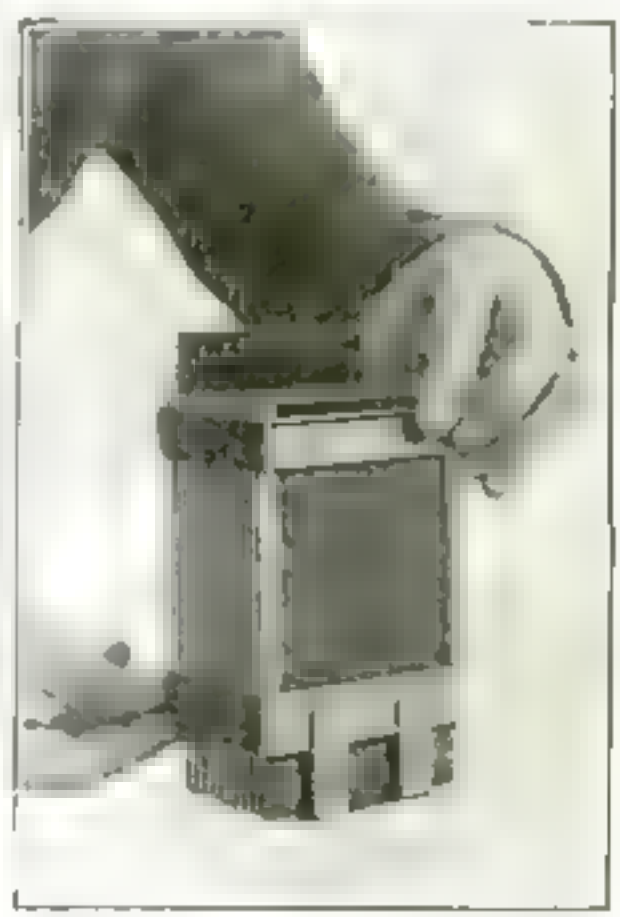
The plates are now ready to receive the developing and fixing bath. It is not necessary that all twelve plate compartments be filled to carry out the developing operation. One plate may be developed as easily as twelve. However, twelve plates can be developed at the same time and the solutions saved each time.

Introducing a plate into the tank. The handle is pulled back just long enough for the plate to pass through



Pouring the developer into the tank through the funnel. The plates are left in the solution for about ten minutes

Placing the camera plate-holder in the transferring hopper for its entrance into the tank. It is securely held in place by a lock-bar. Afterwards the plates are washed and placed in the fixing bath in the same way for fifteen minutes

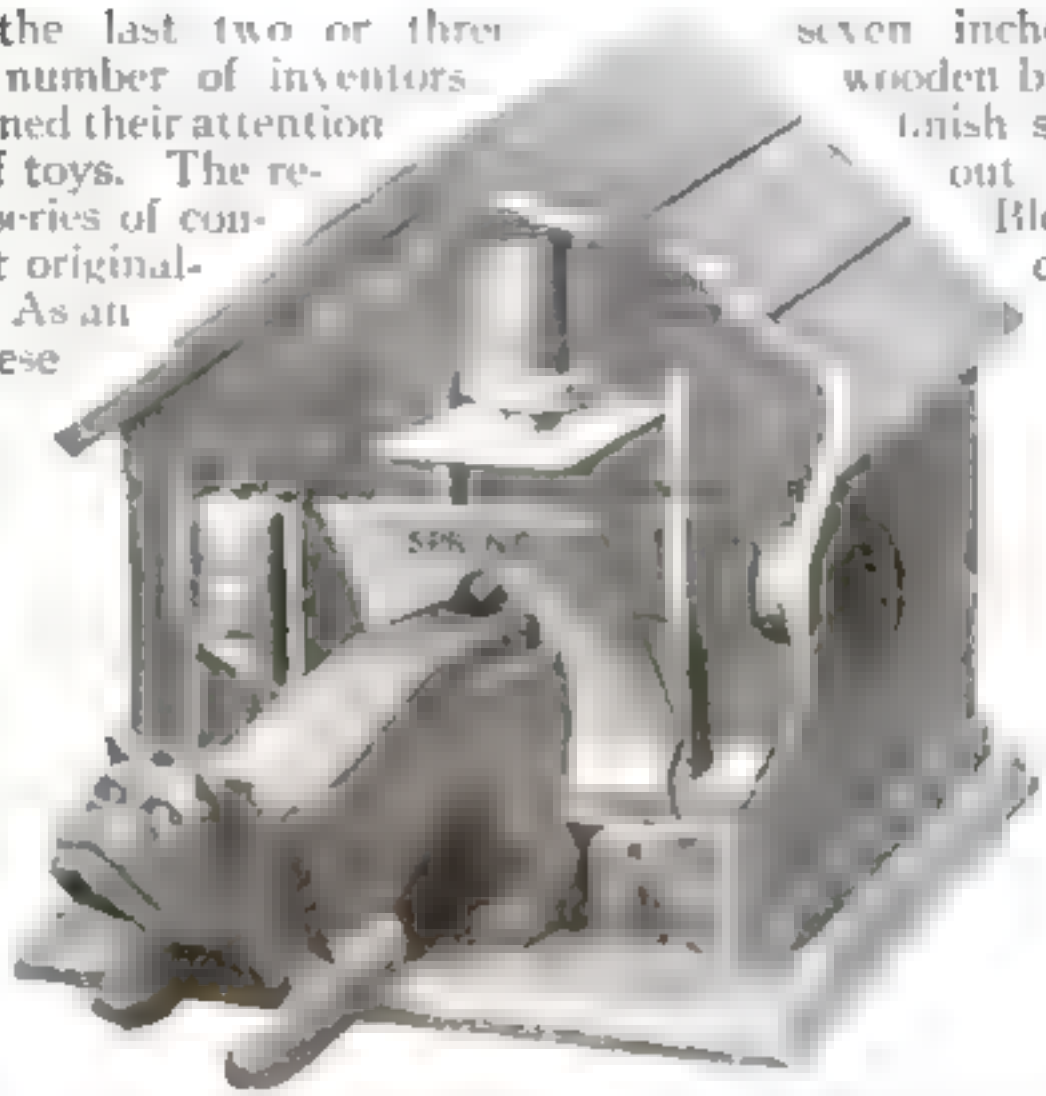


The plates removed in bulk from the tank after the fixing bath. They are now ready to be thoroughly cleaned and dried

Toys That Obey Your Voice

Talk, sing, whistle, clap your hands and they perform their antics for you

WITHIN the last two or three years a number of inventors have turned their attention to the making of toys. The result has been a series of contrivances of great originality and novelty. As an example of these new arrivals, the various sets made up of toy I-beams and cog-wheels and such by which young builders construct marvels in the way of bridges and engines and clocks, etc., may be cited. Still another toy consists of long wooden rods which may be put together in such assorted ways that anything from a windmill to a realistic airship may come into being. But for sheer novelty, a new style of toy devised by a New York inventor, Mr. H. Christian Berger, has easily strongest hold on the attention.



The secret of the wireless pup's obedience to the clapping of your hands is a microphone

Everybody knows that a loud sound may so jar a telephone transmitter that it will cause a wave of electric current to flow through an electromagnet, or in some cases, a relay, and cause the electromagnet or the relay to act. If the jar is great enough to cause the electromagnet to release a spring or lever you can imagine the possibilities.

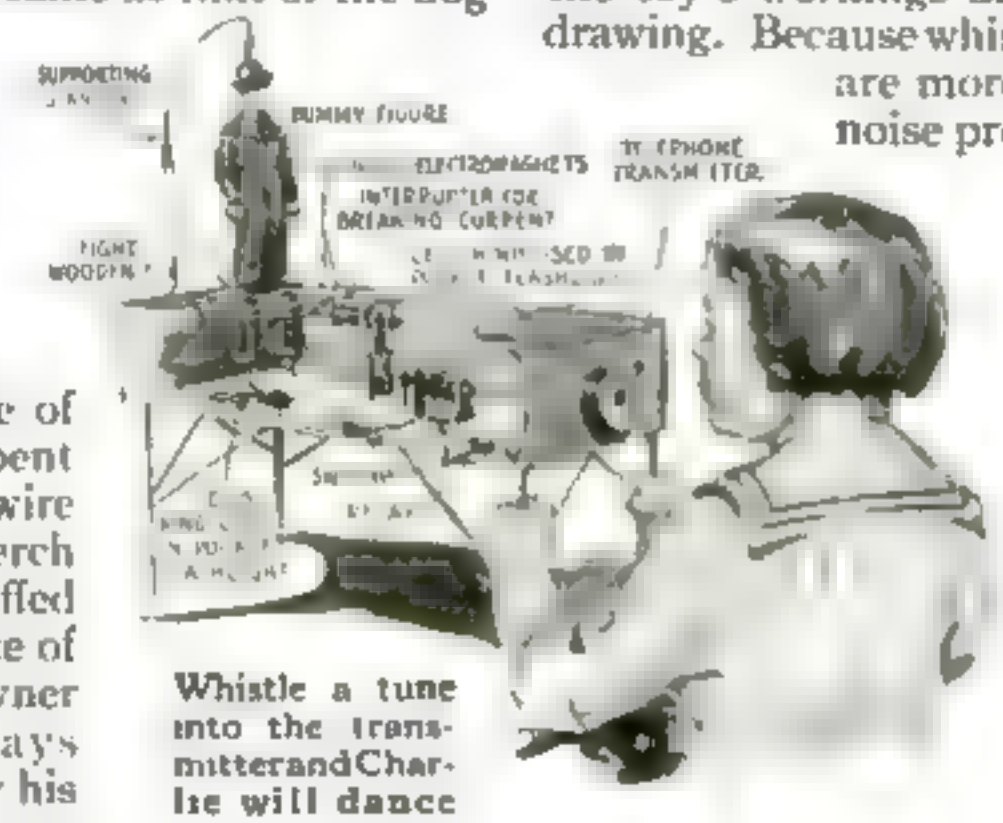
On this principle Mr. Berger has built a little kennel six or seven inches high with a wooden bull-dog in mission finish standing half way out of the entrance. Blow a shrill whistle or clap your hands and the dog instantly leaps out of his kennel. He seems alive, and yet, when you pick him up, you find that he is so much dead wood, without a spring or mechanical attachment of any kind. The explanation is that the sound of the whistle or of the hand-clapping has affected a telephone transmitter concealed within the kennel, causing an electromagnet to release a spring which propeled the dog outward.

Still another toy which utilizes the sound-wave-telephone-transmitter principle is an imposing toy bank. To deposit money in the bank, you place the coin on a lever lying across the front steps, clap your hands, and presto!

Place the coin on the lever, clap your hands, and presto! the lever "flops" it into the bank

the lever "flops" the deposit straightway into the bank, a hole luckily having been cut in the front door at a convenient point to permit this hurried entrance of the coin. No deposit slips are needed. The bank will as readily accept a trouser's button or any other flat round object as it will a coin. However, the contrivance has enough action to adequately satisfy all demands made by a youthful banker. The interior mechanism of the bank is much the same as that of the dog kennel.

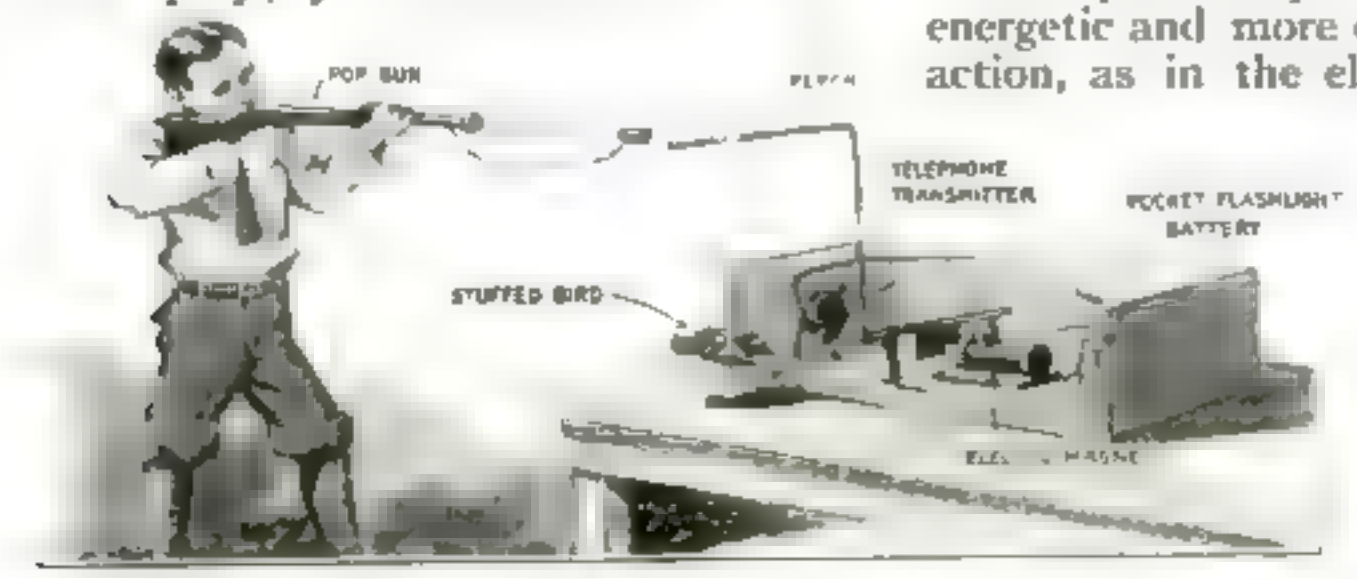
In a third toy the loud report from a gun actuates the mechanism. The machinery is contained within a box from the side of which projects a bent piece of heavy wire serving as a perch for a small stuffed bird about the size of a canary. The owner of the toy plays sharpshooter. By his accurate marksmanship he causes the bird to depart this life. The weapon with which he is equipped is a deadly "pop-gun," which fires the usual cork projectile, tethered to the gun-barrel with a string. Standing off several feet from his prey, the young sharpshooter takes careful aim. Bang! Off falls the bird from his perch, theoretically shot dead. It even matters not that the cork could go no further than the yard or two of limiting string; the bird is "shot" just the same. Likewise (and whisper it!) the marksman can even point the gun at his own head instead of at the prey; yet the bird on the other side of the room falls off its perch precisely as before. The explanation is that the sound from the gun has affected a form of telephone transmitter as it did in the other toys, here, however, resulting in a jiggling of the bird's perch, causing it to lose its equilibrium and to fall off.



Whistle a tune into the transmitterandCharlie will dance

In the fourth contrivance a dummy figure is made to dance a jig in response to a tune whistled or sung. Details of the toy's workings are explained in the drawing. Because whistled or vocal sounds are more delicate than the noise produced by clapping hands or the shooting of a gun, it is necessary in this toy to insert a relay in the telephone transmitter circuit. The transmitter works the relay and the relay controls the dancing. In the other toys the transmitter is directly controlled. The dummy produces a variety of weird steps from a Charlie Chaplin shuffle to an old-fashioned Negro "hoe-down" dance.

The application of the principle is only limited by the imagination and ingenuity of the inventors and manufacturers. It will be a great relief to Santa Claus to find that he is to receive this kind of help in his toy-making; for the poor old fellow has been sadly perplexed during recent years by the precocious brand of twentieth century youngsters, who are constantly demanding something different and preferably something capable of energetic and more or less spontaneous action, as in the electromagnetic toys.



The bird never fails to fall off. It is the "bang" and not the shot that theoretically kills him. For instance, point the gun at yourself and he will fall off just the same

Boring by Photography

Keeping a Deep Hole Straight

IN ALL deep borings the diamond drill deviates considerably from its starting direction, and it is sometimes very desirable to obtain a survey of the hole. The device here shown, which is the invention of Charles B. Galvin, of Cornwall-on-Hudson, New York, consists of a steel tube, ranging from fifteen to thirty feet long, with means for indicating and recording any departure of its axis from a straight line. A geometrical straight line, tangent to the curving axis of the hole, is established by the projection upon a disk of sensitized photographic paper of the image of cross-hairs etched on clear glass. Thus, if the hole is perfectly straight the image of the center of the cross-hairs will coincide with the center of the paper disk, and if not, the distance from the image of the center of the cross-hairs to the center of the disk represents the amount of deviation or rate of curvature of the hole.

The vertical and horizontal directions are established on the paper prints by means of the image of a weight, which may be either a plumb-bob or a ball, free to roll to the lowest point immediately in front of the paper. A diameter drawn through the center of the paper and the center of the print of the ball or axis of the bob indicates the vertical and the one at right angles to this, the horizontal. To these lines the lateral and vertical deviations respectively are referred.

A source of light, which may be a one or two-candlepower battery lamp, current for which is supplied from the surface via the cable, is situated in the focus of a condenser-lens. A well-defined image of the cross-hairs is thus projected on to the paper disk at the other end of the tube, by means of the objective lens which is interposed at the proper focal distance between the cross-hairs and the paper. The distance from the cross-hairs to the objective would usually be from two and a half to three and a half or four feet and from the objective to the paper, from twelve to twenty-five or thirty feet.

Applying the photographic [illegible] to determine whether it is straight or not. The sensitized photographic paper is at the extreme bottom of the device

Above: A photograph which represents the amount of deviation or rate of curvature of the hole. At left The location and arrangement of the photographing device. The lamp is at one end of the tube and the photographic paper at the other

Defending the United States with Motor Torpedo Boats

How deadly torpedoes can be safely carried on high-speed motor boats and how the landing of an enemy could be prevented by their means

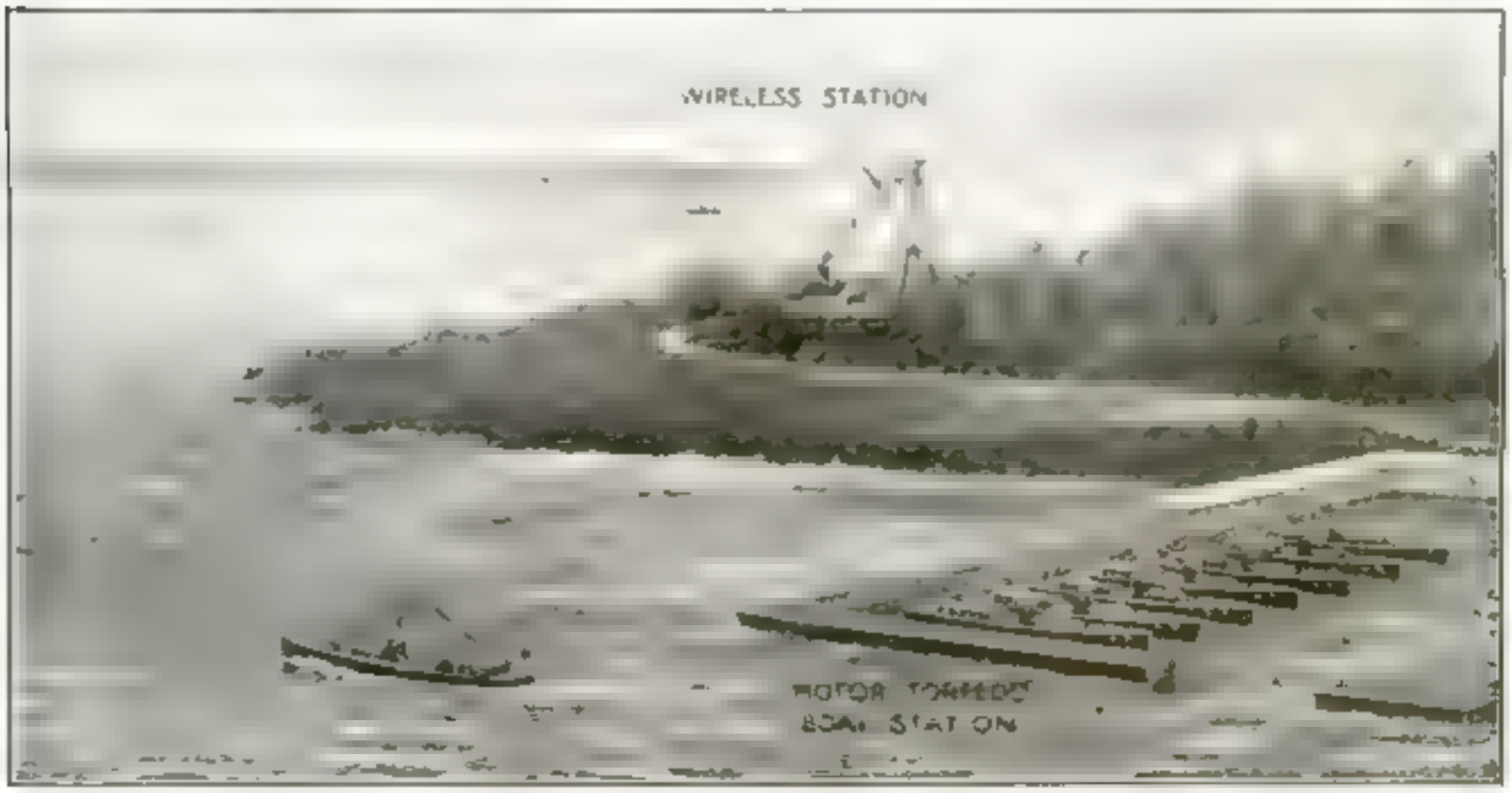
By Edward F. Chandler

ON THE Atlantic coast alone there are no less than one hundred and sixteen undefended points where an enemy could land troops. New York, long considered invulnerable, is in reality helpless. Its guns are so mounted that an enemy fleet could lie off Far Rockaway and throw shells into Fourteenth Street. Not one of our guns could touch the invader.

Our own army officers have pointed out that 400,000 men could easily be landed on the Atlantic coast; that they could possess themselves of a line three hundred miles long, extending from Lake Erie to Chesapeake Bay; that they could hold that line at the rate of one man for every three yards or 176,000 for the entire length; and that the rest, 224,000 strong, could cut off ten of our states, all of our great manufacturing establishments, our munition plants, and our richest cities and financial institutions from the rest of the Union. In our harbor defences we have less than 15,000 men, who must remain where they are stationed to serve their guns.

Against this foreign invading force we could oppose no adequate resistance. The popular notion that we "can lick all creation" with pitchforks and shotguns finds no justification in our military history. In the War of 1812, Washington was defended by 5,400 raw recruits, mostly militia and volunteers. About 1,500 British soldiers ignominiously drove out the American defenders of the capital with a loss to themselves of only eight killed and eleven wounded.

Years must elapse before our coast defences and our mobile army can be developed into fighting units capable of frustrating an invasion of our seaboard states. In the meantime we must make the most of the civilian *matériel* at hand. And so we find that during the month of September the Navy taught a handful of motor-boat owners how to look for sub-



Each of the proposed motor torpedo-boat stations would be equipped with wireless sending and receiving instruments and would harbor from ten to fifteen boats

marines, how to locate mines, how to act as scouts and patrols, and how to perform, in general, the functions of a mosquito fleet. The Navy Department has gone even further. It has recommended the adoption of designs for power boats, which are to be so constructed that they can mount a gun in the bow in time of war and yet not interfere with their use as pleasure craft in time of war. These vessels can be employed only near shore for patrol duty.

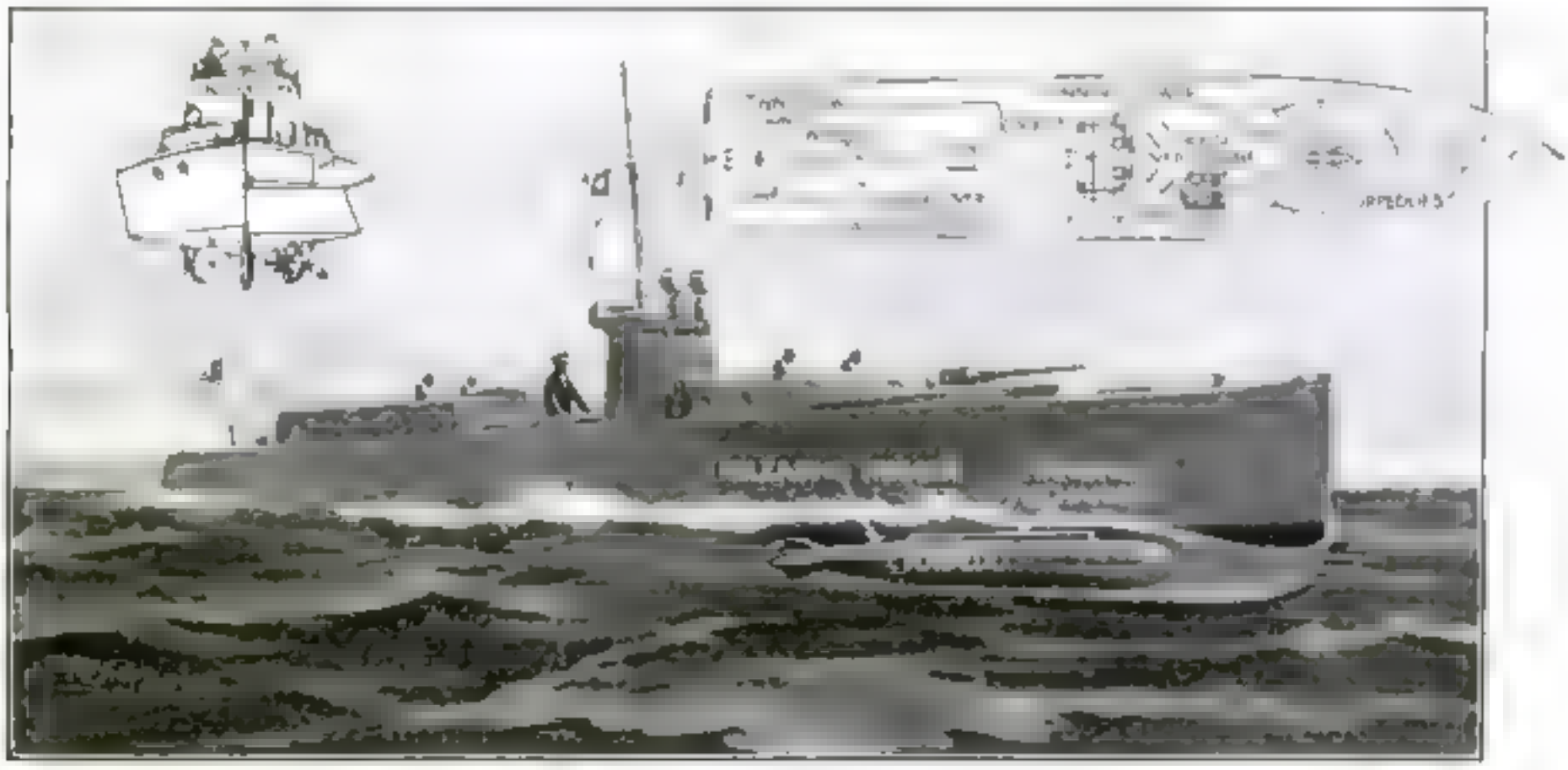
Our thousands of miles of coast line can never be so perfectly protected by shore batteries that a landing by a hostile force is impossible. A powerful navy must always be relied upon to engage the fleet that is convoying a fleet of hostile transports. Since we are a fourth rate naval power it is not likely that our ships will be able to cope successfully with the superdreadnoughts and battle cruisers of any great European power. It would seem as if the transports would surely land their troops after the defeat of our small battle fleet. Coast defence submarines would naturally be used to thwart the attempt at landing troops. They must be mobilized for the purpose. At present our submarines are inferior to those of Germany or England, and we have not enough of them to defend thousands of miles of coast. What is more, a modern submarine costs $600,000.

Limitations of the Motor Boat

It is very evident that we need a weapon of defence which can be created almost overnight, as it were, which shall be at least as effective as a submarine, and which will appeal to the imagination and patriotism of coast dwellers. No doubt the motor boat meets the situation, and for that reason the efforts of the Navy Department to enlist the services of motor boat owners in the cause of national defence are commendable.

But the possibilities of the motor boat were hardly revealed in the recent maneuvers. Handled as they were last September they would have been powerless to prevent the landing of an enemy. Our Navy Department sees in the motor boat only a scout, a submarine antagonist, a mine detector, and not its larger possibilities.

There is no reason, to my mind, why the high-powered motor boat should not be employed to carry and discharge torpedoes. A torpedo, whether it is carried and discharged from a submarine, a torpedo-boat destroyer, or a motor boat will sink the largest battleship with equal effectiveness. But it must be carried safely and launched accurately. How this can be accomplished the accompanying illustrations of a motor boat of my own design reveal.



The torpedoes are attached to the hull, one along each side of the keel. Above: Diagram of the plan of the motor boat and end view showing the torpedoes suspended in position

Should an invasion of the United States be attempted the first troopship to appear on the horizon would be immediately attacked from all directions by the mosquito fleet

A modern torpedo is nineteen feet long and twenty-one inches in diameter, and it weighs over a ton. Obviously it cannot be carried on the deck of a small motor boat, or in an overboard tube. Accordingly I have devised a method of attaching torpedoes to the hull itself, one along each side of the keel. Thus supported the torpedoes neither add nor subtract from the weight of the vessel; for the torpedoes have neither positive nor negative buoyancy. There may be a slight reduction in speed; but that disadvantage is far outweighed by the formidable character of the weapon carried. No launching machinery is required; the mere starting of the torpedo-propeling machinery is enough for launching. The torpedo is so suspended that it can be dropped off, whatever may be the speed of the vessel. Still more important, the torpedoes are launched with the motor boat bow on, thus facilitating fire-control. The motor boat need only be pointed at its target; a torpedo launched from a deck-tube, athwartship, as on a torpedo-boat destroyer, may miss its mark because of a heavy roll. To be sure a motor boat will pitch; but pitching is never so marked as rolling and is more easily allowed for.

But is it not dangerous to carry torpedoes in this way? May not the motor boat be blown up by its own weapons? Rare experience convinces me that so long as the pistols in the warheads of the torpedoes are locked (and they will be unlocked only when the torpedo is to be fired) there is no danger. A warhead, even though it is filled with five hundred pounds of guncotton can withstand a severe shock.

At intervals of about one hundred miles along our coast stations would be maintained for ten or fifteen motor boats.

How the Motor Torpedo Boats Would Defend Us

Imagine, now, an attempt to invade the United States. Two hundred miles at sea our fleet is engaging the enemy's battleships in an effort to stop him from reaching our shores. The outcome of the battle is at least doubtful. Meanwhile his transports steam on. A motor scout sees them. At once the wireless telegraphic key of a radio operator flashes to the nearest boat station the number of the transports and their bearing. The news is wired from station to station. A veritable swarm of motor torpedo boats sets out. Their commander employs regulation torpedo-boat tactics; a dozen boats are sent against a single vessel; one at least will strike a telling blow. The boats lie low; they are difficult to hit. The enemy's transports, on the other hand, are large and very distinct. Moreover, the range is a mile and a half. The pistols in the war heads are set. A half dozen torpedoes are launched at once against the broadside of the transport. There is the thunder of an explosion; a troopship dives head foremost into the waves; three regiments perish.

The Automobile Street-Car

Six-wheeled traffic carriers which are remarkable for their short-turning radius and for their flexibility

EVOLVED from the jitney, a new type of trailer has been built to convert any automobile into an eighteen-passenger bus. It is based on the century-old principle that an animal or vehicle can pull more than it can carry. Yet the vehicle is new in that it is the first application of the trailer principle for hauling passengers, and in that the trailer-wheels track with those of the automobile, to which it is attached by a new means, thus producing a vehicle of short-turning radius, an advantage on congested streets.

An eighteen passenger, six wheeled automobile bus with trailer wheels attached (Fadgl System)

The Fadgl system, as this type of vehicle is called, is adaptable for feeders to trolley lines and as a traffic tester of proposed new routes. It even bids fair to revolutionize street-car traffic in our cities by supplanting the street-car entirely because it makes tracks unnecessary, as well as poles and power houses, on all of which the original outlay and maintenance cost are high.

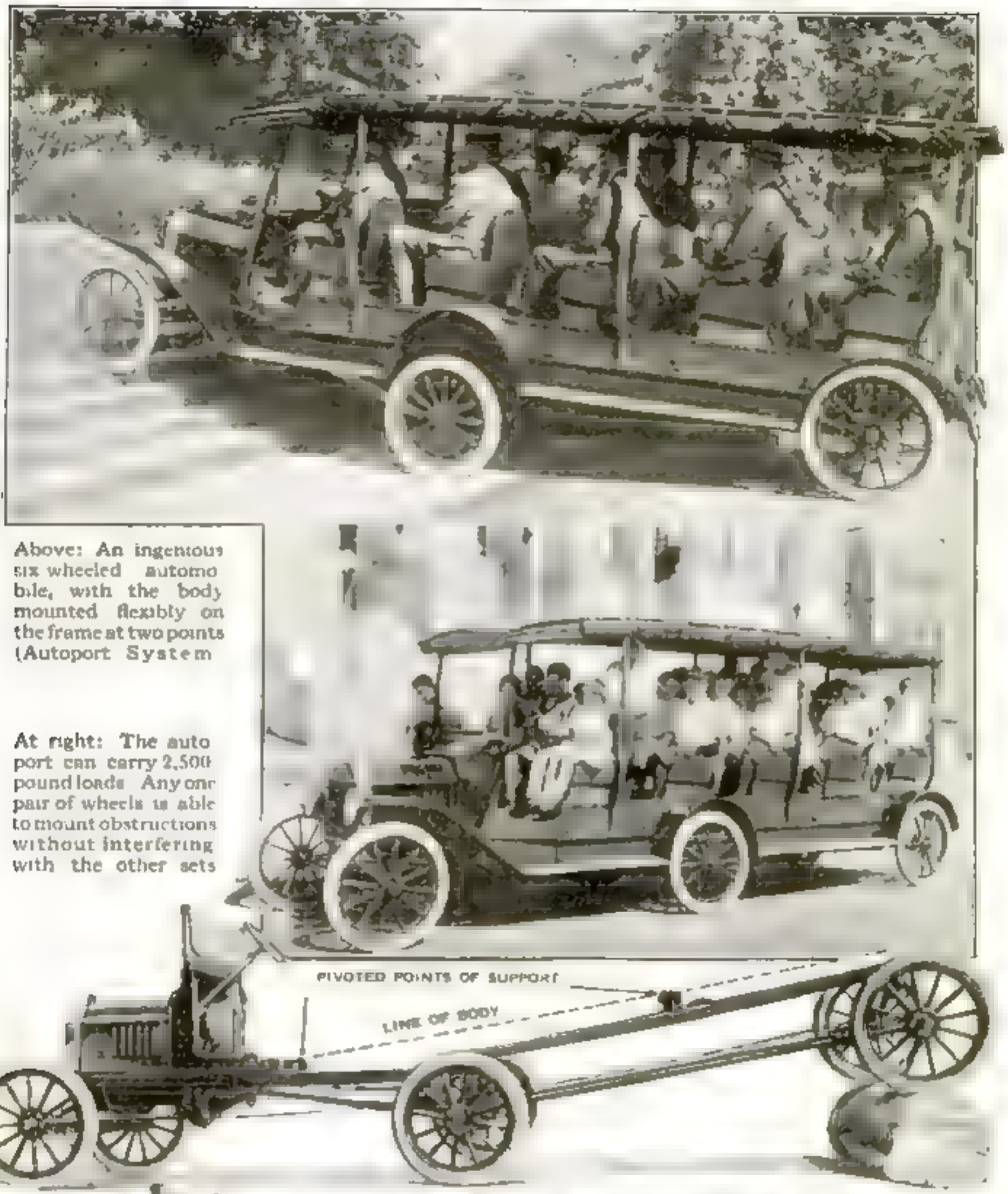
The trailers, which are made in two sizes, one for eighteen and the other for twenty-five passengers, can be attached to any automobile by removing the body aft of the front seat, which is retained for the driver and one passenger. The remaining passengers are carried in the trailer, which is supported on a pivot arrangement at the rear of the automobile.

Another somewhat similar six-wheeled automobile is shown in the illustrations opposite. It differs from the former in that it is made of Ford parts and employs the unusual construction of mounting the body flexibly on the frame at two points instead of attaching it all along its length. The autoport, as the vehicle is called, will carry 2,500-pound loads and may be equipped with an ordinary express body as well as one for bus service.

It consists of a Ford chassis to the rear of which is connected a two-wheeled trailer made up of the front end of a second Ford frame, front axle, spring and wheels, the latter being the rearmost wheels of the completed vehicle. In addition to this frame, which is pivoted to the rear end of the chassis frame on a crosswise bar, there is another rectangular wood framework which joins the rear wheels to the housing of the Ford driving axle, or that on which the middle pair of wheels is carried. The forward end of this framework is also mounted on pivots on two straps around the axle casing, one near each wheel. The body is pivoted to two crossbars on the metal Ford frames, each bar being midway between the center wheels and those at the front and rear, thus tending to distribute the load equally over the six wheels.

Due to the pivoted connections of both the trailer frames and that of the body, any one pair of wheels is able to mount road obstructions without raising the body an equal height. The steering arms of the front and rear sets of wheels are connected by longitudinal cables attached to pivoted triangular-shaped equalizers at each end. Thus in rounding corners the front and rear wheels turn at opposite angles, tracking with each other and giving a short turning radius, one of the special features.

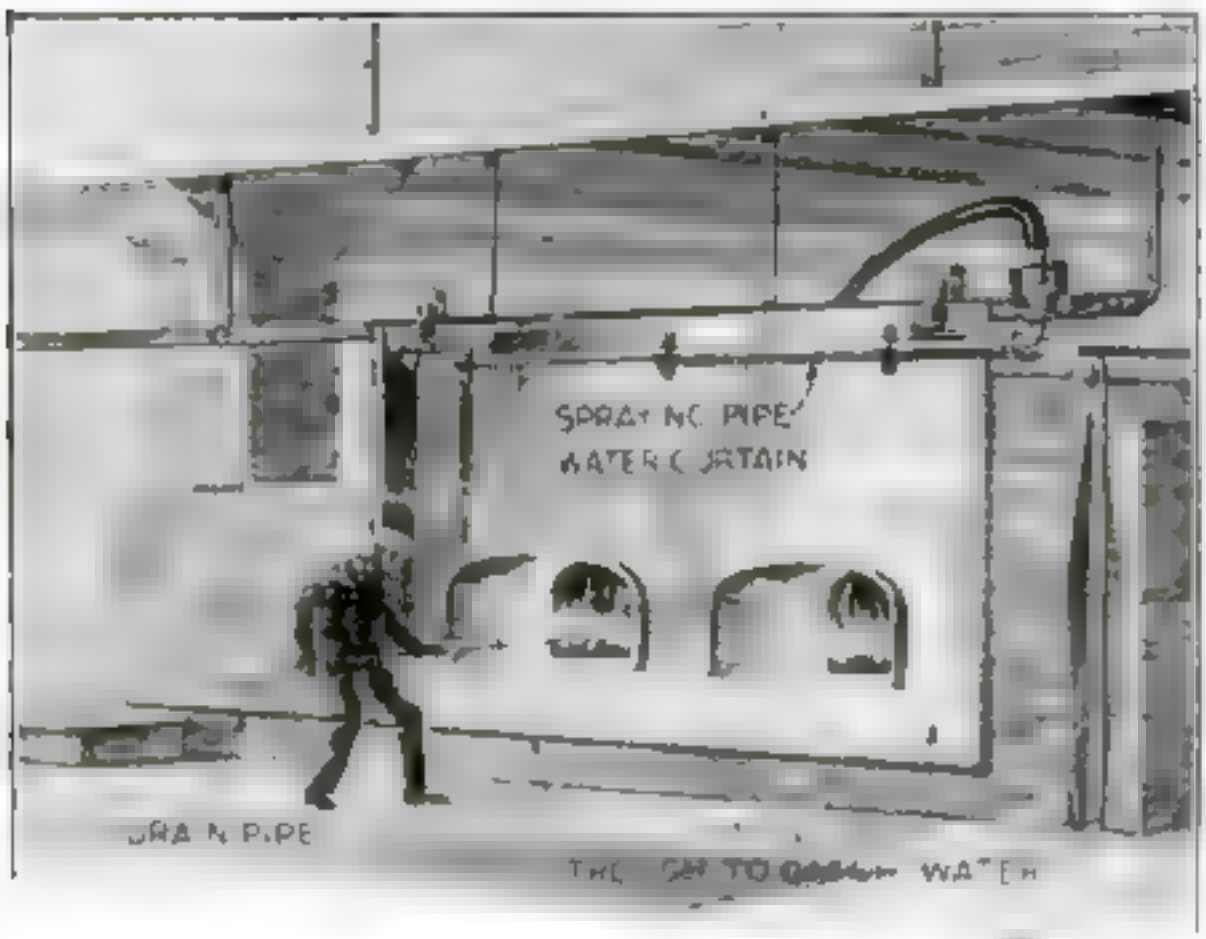
Wonderful Six-Wheeled Automobiles



Above: An ingenious six wheeled automobile, with the body mounted flexibly on the frame at two points (Autoport System

At right: The autoport can carry 2,500 pound loads Any one pair of wheels is able to mount obstructions without interfering with the other sets

Above and below: The two pivoted points of support in the autoport system distribute the load equally over six wheels. The steering arms of both front and rear wheels are connected by cables to equalizers at each end



A curtain of cold water falling on a screen in front of the furnace partially neutralizes the effects of the terrific heat

A Water Curtain to Protect Workmen from Intense Heat

IN OUR rolling mills the output of finished material falls off in the hot summer months, due to the intense heat radiated by the furnaces. Several means have been devised to protect workmen from these infernos. Among the most recent is a water curtain shown in the accompanying illustration.

It consists of a rectangular-shaped sheet-metal screen suspended by three door-hangers placed on an iron track.

The two furnace entrances have angle-iron around their edges to keep the water from affecting the fire. Riveted to the bottom of the screen is a trough which receives the falling water and conveys it to a drain pipe. At the top, extending lengthwise, is the spray pipe. This is equipped with a row of small holes in the bottom, through which the water flows against the curtain. The spray pipe is capped at one end.

How Nature Puts the Pop in Popcorn

NATURE has filled a grain of popcorn with tightly packed starch-grains. The interior of the grain is divided into a large number of cells, each of which may be likened to a tin box, the walls of which are sufficiently strong to withstand considerable pressure from within. Upon the application of heat the moisture present in each little box is converted into steam that finally escapes by explosion. In some cases the explosions are of great force.

A very high degree of heat is required for satisfactory popping. This causes most of the cells to explode simultaneously. The grain of corn then literally turns inside out, and is transformed into a relatively large mass of snow-white starch.

A Mail Box Big Enough to Keep House In

EACH year the residents of Syracuse, New York, invite their nearby friends and the rest of the world to the New York State Fair, which has been held in that city for many years past. This year the Syracusans waxed eloquent and designed the huge mail box, shown in the accompanying illustration, for mailing several thousand letter and post-card invitations.

The box is about twelve feet high, six feet wide, and eight feet long. It was so big people couldn't mail their letters in the usual way, so a dainty postmistress was installed.

Large enough to hold a postmistress and thousands of letters and cards

A "Sandwich-Man" Clad in an Imitation Bullet

NO, THIS is not a new type of diving suit, or a patent respirator used to repel a gas attack, or a new-fangled barrel for the fellow who has lost his clothes. It is merely an advertising stunt, a sort of super-sandwich-man, to attract the eyes of the curious. On the back of the device are letters which describe a product on the market. The conical headpiece resembles aluminum, and a circular opening is cut in it just large enough for the wearer to see his way ahead and breathe comfortably The shorter the wearer the more mysterious becomes the appearance of the powderless bullet If no part of the body except the feet are visible as the bullet wends its way down the avenue, it is pretty sure to be the cynosure of thousands of wondering eyes. .

The newest recruit to the peaceful army of "sandwich men"

Why Gold Pieces Are Always "Doctored"

WHY don't jewelers melt up $10 and $20 gold pieces in order to use the metal in the manufacture of gold jewelry? Indeed, gold pieces were used some forty years ago by enterprising jewelers and with success, too—until the practice was stopped in a very novel but effective way. In those days jewelers bought enough $10 and $20 gold pieces for the work in hand. The gold was melted, the necessary alloys were added, and all manner of fine Etruscan work was turned out.

It was not long, however, before the Government began to wonder what was becoming of its gold pieces The officials knew the people were not hoarding gold, so a quiet investigation took place. It was then discovered that the makers of gold jewelry were to blame. Having found the cause, it was not difficult for the officials to find a cure. They did it by "peppering" the coins with iridium. Resembling black emery in the crude state, iridium requires a heat of 3,542 degrees Fahrenheit to melt it. Gold, on the other hand, can be melted at 1,913 degrees Fahrenheit. It is easy to see, then, how the unsuspecting jeweler, melting up his gold pieces at the temperature required, got a large number of unmelted specks of iridium in his metal when it cooled.

You can imagine his dismay when his analysis and deductions revealed that he had been trapped.

Kneading Potter's Clay with the Bare Feet

THE illustration shows a man subduing a pile of recalcitrant clay. If it were possible to use his hands in kneading the clay the man would no doubt prefer to do so, but without a mechanical kneader he is obliged to use his feet, which method has been used for many centuries in the old world.

It requires no little amount of strength to knead clay, and when the feet are employed the weight of the body is utilized.

A modern potter kneading clay with his feet, as it was done in the days of Cleopatra

Quebec's Disastrous Bridge

How the principle of a diver's spring board is applied in the building of the biggest cantilever bridge

By C. E. Drayer

One of the cantilever arm-compression diagonals being placed in position. Like the operations of an army in the field, the work of erection has a dash of danger and romance. As the success of the army in action is due to the output and character of the shops behind the lines, so the speed of erection of a structure is due to the excellence of the shop work

THE new Quebec cantilever bridge ranks among the most important and brilliant of all construction. The boldness of a great general in war pales by the side of the courage of its builders, who had little precedent to follow in some of its vital and most difficult features of design and erection. Besides, they had to proceed in the shadow of the ghastly catastrophe of its predecessor which crumpled and fell, carrying to death nearly a hundred men.

That this shadow was not an imaginary one is evidenced by the recent disaster when the suspended span fell from fifteen feet above the water while being hoisted to position. The best engineers in American erred not in design, but, if at all, in failing to be superhuman. The latest failure can delay for but a short time the finishing of the great structure. Very soon the successful placing of a new span will be recorded.

It all happened in about five seconds. While practically all dependable evidence of the cause of the last disaster is under two hundred feet of water, eye witnesses agree that, following a report like a cannon, the south upstream corner slipped off its lifting girder and corkscrewed into the river.

The most probable explanation of the failure is that the steel rocker casting under the south upstream corner suddenly crumpled (see diagram page 732). The truss then dropped on the short carrying girder, kicking it out, or

turning it enough to let the corner of the truss slip off. Had the accident happened an hour earlier, many prominent engineers of the United States and Canada who were on the span witnessing the lifting would have been lost. As it was but a dozen lives were lost.

The failure of the summer of 1907 cannot happen to the new bridge. While the lower chord of the old bridge was but four and a half feet square and had seven hundred and eighty-one square inches of solid steel in its cross-section, the same chord of the new bridge is seven feet two inches deep and ten feet four inches wide and has a cross-section of nineteen hundred and two square inches of steel—two and a half times the amount in the old bridge.

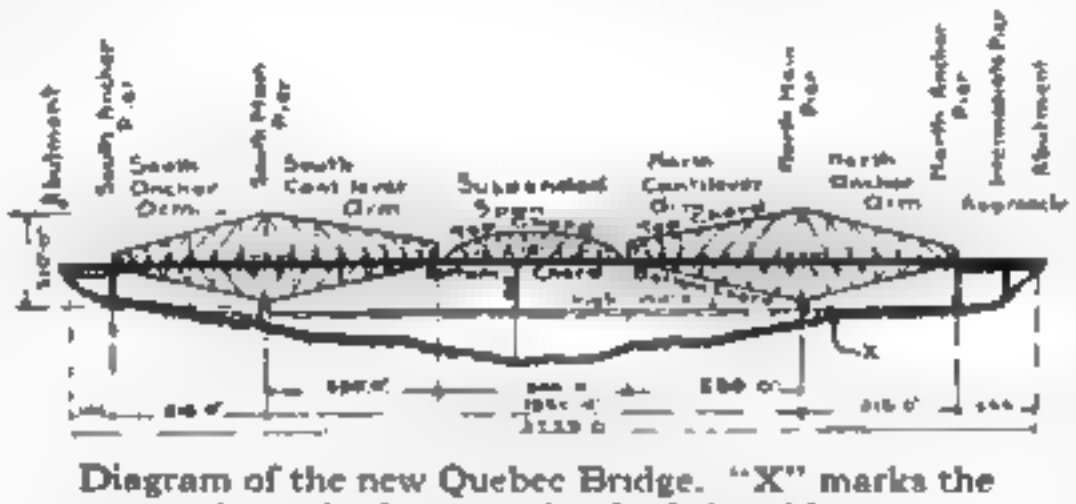
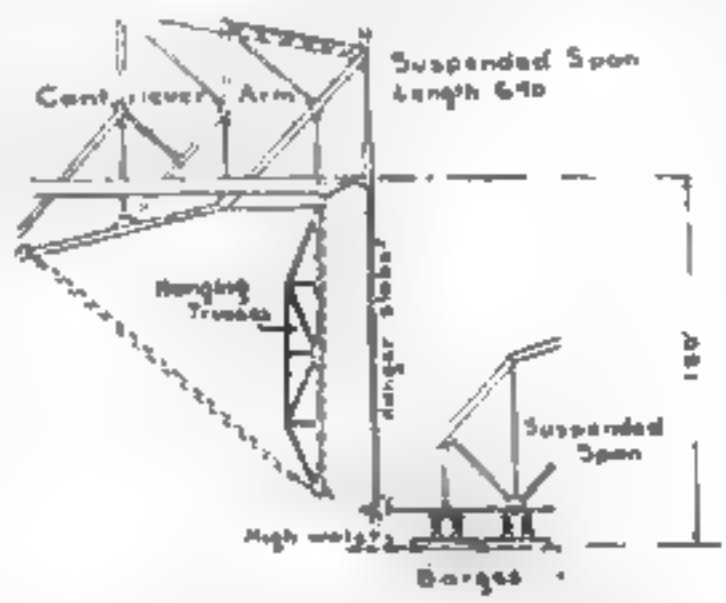


Diagram of the new Quebec Bridge. "X" marks the point where the bottom chord of the old structure crumpled. The expansion of cantilever arm and suspended span, due to temperature changes, is taken up by brake shoes at the connections, each capable of resisting a force of one hundred and twenty-five tons. Even the difference of temperature, due to one side of the bridge being in the sun and the other in shadow, was calculated with accuracy

The familiar spring board at the swimming hole is a good example illustrating the principle of cantilever construction adopted for the Quebec bridge. The load is carried by the projecting portion, which is supported by a weight at the back end sufficient to keep it from raising. The suspended span is like the boy standing on the end of the spring board. The suspended span and cantilever arm tend to raise the anchor arm, which must be heavy enough to prevent that under any circumstances. Naturally the bridge engineers desired to keep the suspended span and cantilever arm as light as possible. Hence they made all the truss members of the suspended span and the greater part of the trusses of the cantilever arm of nickel steel, which contains one per cent of nickel and is one third stronger than ordinary steel.



The method of raising the suspended span in position. When the tide came in, the span was afloat and was towed by tugs to the bridge, where it was anchored to the hanging trusses and coupled to the hanger slabs. It was raised by hydraulic jacks

The designer must consider first the natural and artificial limitations of the location and then the traffic to be carried. At the location of the Quebec bridge, the channel of the St. Lawrence River is nearly two hundred feet deep. The stream is swift and subject to high tides. The traffic of ocean-going ships must not be interrupted. These considerations, together with the kind of foundations available, determined that the span over the channel should be eighteen hundred feet long, ninety feet longer than the famous Firth bridge in England, heretofore the longest span ever built. The length of span, together with economy and rapidity of erection, determined the type of bridge, a cantilever. The bridge will carry a double track railroad and two sidewalks.

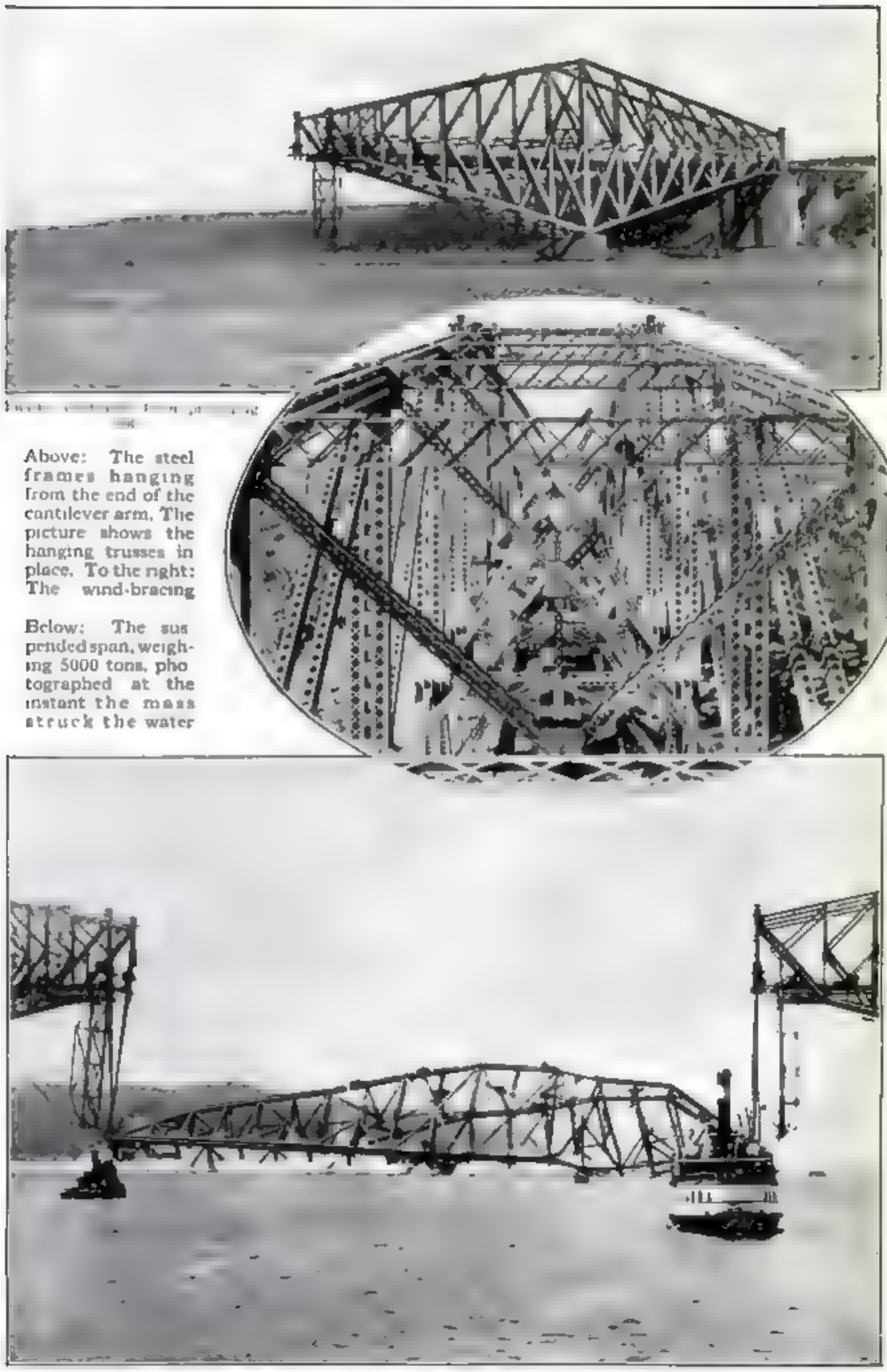
After the main dimensions of the steel, "superstructure" it is called, had been figured out, plans for the masonry were made. The north stone masonry pier was carried to fifty feet below the bed of the river, twenty feet above bed rock, where a satisfactory foundation was found in the form of large and small boulders firmly wedged together. The south pier encountered sand for the whole distance So it was carried to bed rock, eighty-six feet below the river bed. Most of the sand was removed by blowpipes

The Quebec Bridge A Modern Wonder of the World

The Quebec Bridge has a span over the channel of eighteen hundred feet which is four feet longer than the famous Forth Bridge and the longest span built. Near the main post the bottom chord for each panel weighs 448 tons making it necessary to split it into four pieces in order that it could be carried by railway to the site

To the left, a picture showing how the boom of the anchor arms was erected on temporary staging. In order to manufacture the steel work an entirely new plant was built, equipped with machinery of unprecedented size and accuracy costing a million dollars

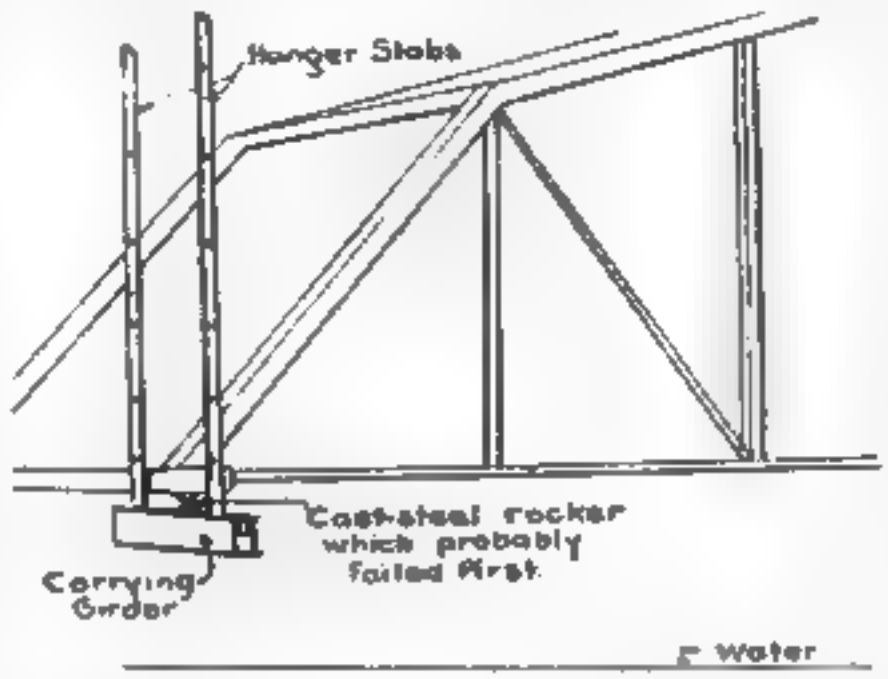
Below is shown the bottom chord of the cantilever arm. The men are standing at the pin bearing for the main shoes. The diameter of the pin is forty five inches. Each rib is eight inches thick



Above: The steel frames hanging from the end of the cantilever arm. The picture shows the hanging trusses in place. To the right: The wind-bracing

Below: The suspended span, weighing 5000 tons, photographed at the instant the mass struck the water

If the reader will pause a moment to look at the accompanying photograph of the bridge, he will note a series of perfectly good capital K's made up of vertical steel posts and diagonal rods. This picture shows also the traveler, which is nothing more or less than a great steel tower carrying gigantic movable cranes on top to handle the heavy pieces of steel, some weighing one hundred tons. By examining the diagram of the bridge, it will be seen that both north and south sections of the bridge, symmetrical about the main piers, are made up of a series of K's. The "K" system has a number of advantages for a bridge of great size. Chief of these is that during erection of the cantilever arms, each panel or "K" can be completed without temporary supports and the traveler moved out to the end. It will be remembered that conditions at this bridge site made temporary supports out of the question.



How did the disaster occur? Probably the steel rocker casting under the south upstream corner suddenly crumpled. The truss then dropped on the carrying girder, kicking it out or turning it enough to let the corner of the truss slip off

The top chords of the arms are in tension; that is, the forces acting upon them tend to stretch them. So, they are made up of great eyebars, thirty-two of them on either side of the main posts having a cross-section of eight feet of solid steel. The bottom chords are in compression; that is, the forces acting on them tend to shorten them.

The great post over the main pier is three hundred and ten feet high and weighs fifteen hundred tons. It is composed of four posts latticed together into a rectangular tower nine feet by ten feet. The shoe under the main post has a bearing on the stone pier of twenty-two feet by twenty-six feet and is nineteen feet high, and weighs four hundred tons. Like some other parts of the bridge, it was shipped in pieces, each weighing one hundred tons. Another measure of the magnitude of this modern wonder of the world is the pin connecting the shoe and tower. It is two and a half feet wide and weighs six tons.

Two sets of massive steel temporary viaduct were built under each anchor arm, one set to carry the floor system, which in turn carried the traveler; the other to support the lower chords the trusses erected up to the point where the vertical and diagonal legs of the "K" intersect. Arriving at the anchor pier, it began to erect above the intersection of the legs of the "K."

During the winter of two years ago, the traveler, weighing a thousand tons, was built on the north shore. In the spring it was moved to the main pier and the shoes placed. The traveler then moved back from the main pier, placing the lower chords on the temporary viaducts. It was moved out to the main pier again and on the way back

Thus the anchor arms were erected. But when the traveler reached the main pier, it naturally had to erect the cantilever arm in front of it, panel by panel. A "flying bridge," projecting forward from the finished work, carried the permanent work of the panel until it was riveted up. The flying bridge was composed of pieces of steel with one end fastened to the completed work, the other projecting out into space and held up by suspension rods.

The suspended span was assembled in a shallow cove some three miles below the bridge at the same time the south cantilever arm was being erected. Six barges thirty-two feet wide by one hundred and fifty feet long were placed under as many panel points. When the tide came in the span was afloat and was towed by tugs to the bridge, where it was anchored to the hanging trusses and coupled to the hanger slabs. The plans were to raise it to its final position in a few hours by eight one thousand-ton hydraulic jacks, two at each corner.

Making the Music Fit the Screen

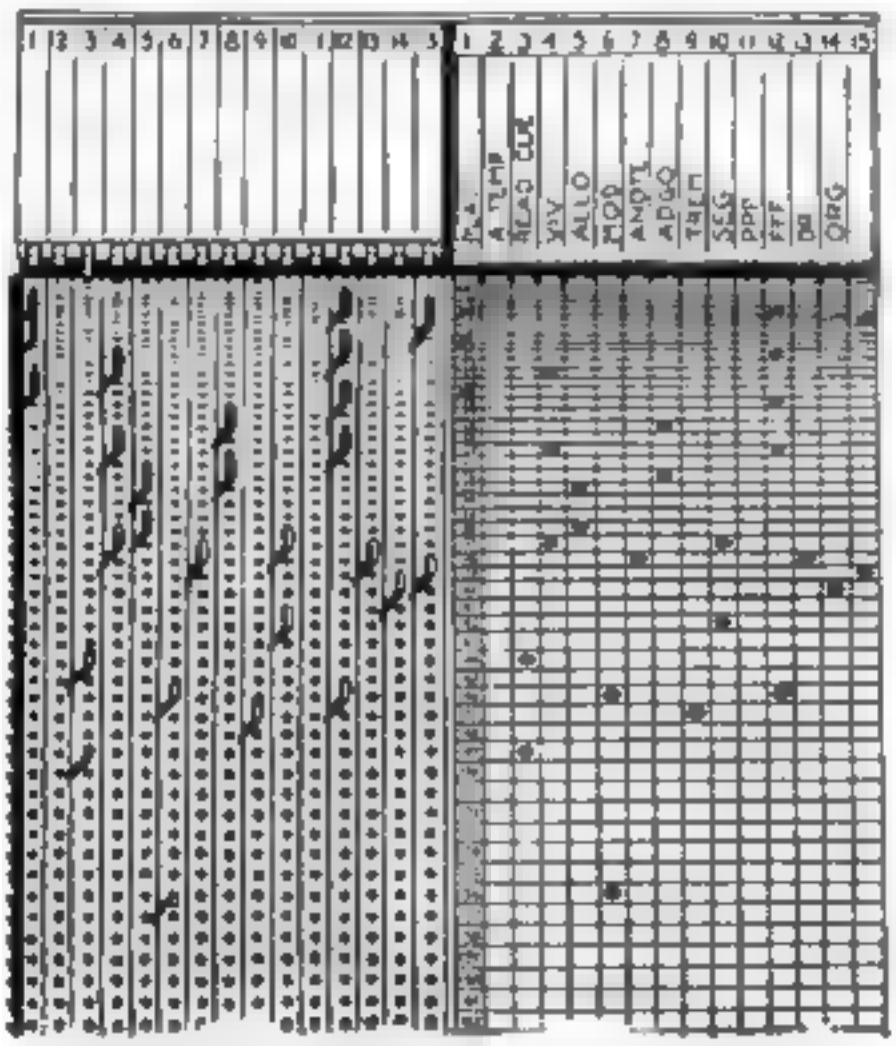
The picture is rehearsed with the orchestra accompaniment and mechanical cues prepared

WHEN the hero's mother is gasping her final blessing as she prepares to depart from the screen to a celluloid heaven and the orchestra in the pit accompanies the pathetic scene with a deafening beating of cymbals and a joyous roaring of snare drums to the tune of "A Hot Time in the Old Town Tonight," it is no wonder that an audience decides that capital punishment for certain orchestra leaders would be an excellent thing.

Even the best moving picture theaters occasionally stoop to "incidental music" which fits certain photoplays about as accurately as a right shoe fits a left foot.

There is only one way to attain a harmonious relation between screen drama and incidental music. The two must be automatically coordinated.

Stanley W. Lawton, general musical director of a chain of New York moving picture and vaudeville theaters, has invented and constructed an electrical orchestra director which accomplishes this harmonious relation. The picture projecting machine in the booth absolutely controls the electrical orchestra director in the pit. The theory of the Lawton photoplay orchestral director, as it is called, is simple. By electricity, signals are automatically flashed to the orchestra from the projection machine on the screen as the picture progresses. Every few seconds a different signal flashes, informing the musicians that sentimental, lively, or tragic music is to be played. The musicians' score and cues have been arranged beforehand during rehearsal. They merely read their part and follow the cues, changing from selection to selection as the signals instruct.



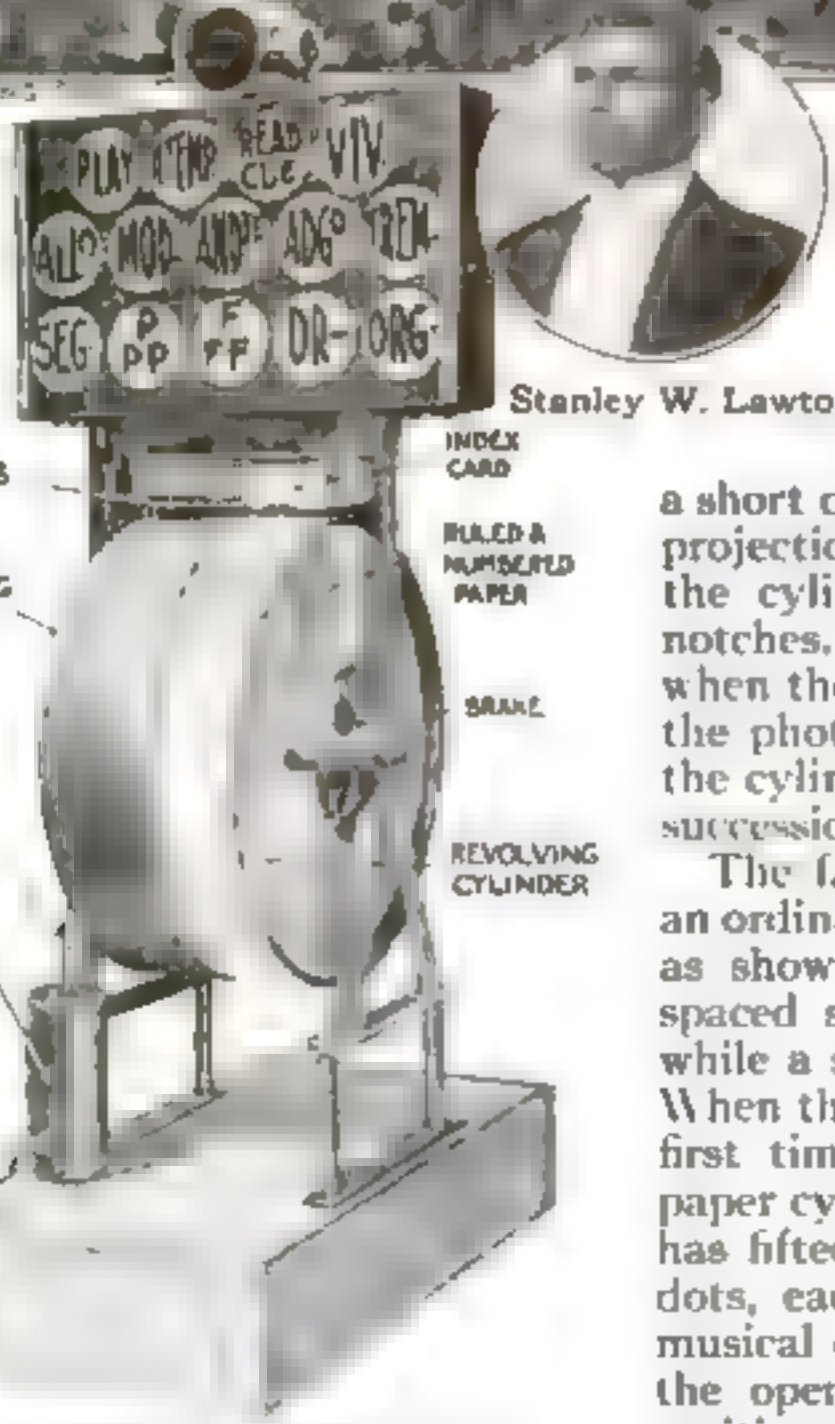
Inflections marked on the paper record are duplicated on the side of the cylinder by steel pegs that contact a magnet

The machine in the center of the orchestra consists of a flat, oblong box with red glass sides, which surmounts a curious looking cylinder or drum. As the films are reeled through the projector, signals flash from the red glass box. For example, if the hero's mother is in death's embrace, the letters "TREM," meaning tremolo, are flashed, and the orchestra responds accordingly.

So accurate is the electrical cueing system that at a recent rather amusing but exacting test given the apparatus, the signal "DRUM" was flashed and obeyed at the very instant when a comedian on the screen hurled a chair through a window.

No matter at how rapid or slow a speed the film is projected, the timing of the cues to the orchestra will be accurate. This precision is obtained by an electric contact-maker operated by a gear on the shaft of the projection-machine handle (see page 735). Every time the handle makes fifteen turns a worm-gear causes electrical contact to be made, and a current passes through wires to the electrical orchestra director,

The cue-machine is placed in the center of the orchestra and signals flash on both sides at once as the film progresses



Stanley W. Lawton

The cylinder is divided into two parts. A ruled strip of paper encircles one side and fifteen lines of small holes the other. The leader makes his inflection marks on the paper at the first rehearsal

which is placed in the center of the orchestra. The current actuates an electromagnet, the plunger of which catches in small notches in the left-hand rim of the cylinder and turns it a short distance. Every time the contact at the projection machine is made, the magnet turns the cylinder a distance equal to one of the notches. The apparatus is so arranged that when the five or six reels of film which constitute the photoplay have been shown on the screen, the cylinder in the orchestra pit has made, in a succession of short steps, one complete revolution.

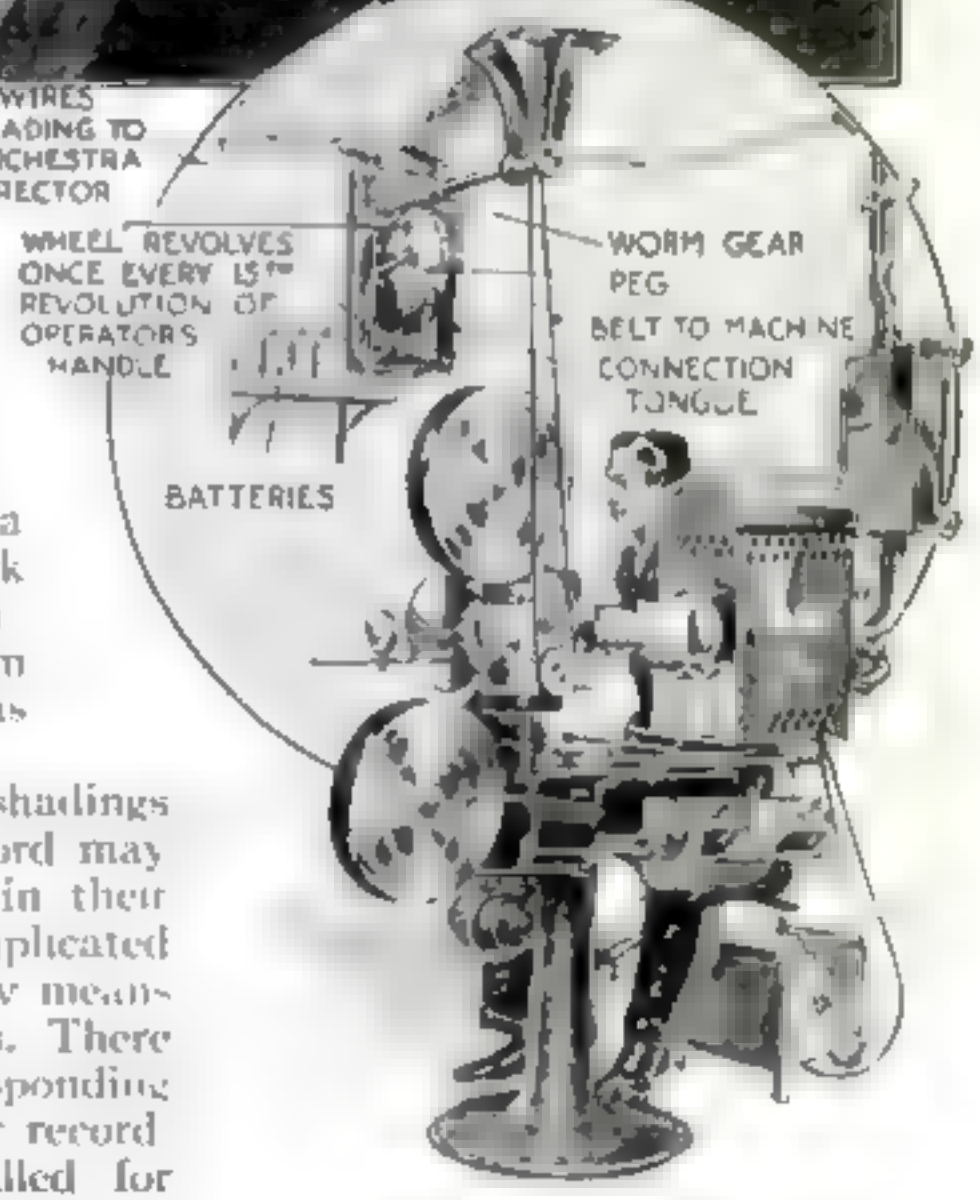
The face of this cylinder which is made from an ordinary steel pulley, is divided into two parts, as shown. Fifteen parallel lines of equally spaced small holes, are bored around one side, while a strip of ruled paper encircles the other. When the orchestra leader views the film for the first time he makes small pencil dots on the paper cylinder, as the drum slowly revolves. He has fifteen ruled off columns in which to place dots, each column being allotted to a certain musical cue. Let us say, for illustration, that the opening scene of the film calls for loud, exciting music. A stationary index-card, fastened on a frame above the cylinder, informs him that fortissimo, or *ff*, shall be indicated in column No. 2 on the paper record. He makes a pencil mark in that space. As the film progresses its dramatic quality changes, let us say, to

A worm-gear connects the shaft of the handle of the projector-machine with the steel pegs of the cue-machine

sentimental. The necessary orchestral accompaniment will be pianissimo. This shading is expressed, according to the index card, in column No. 1. By that time the control device on the projector has moved the cylinder a short distance, so that the pencil mark will be slightly lower than the first one. This operation is repeated until the film has run its course. The cylinder has made one complete revolution.

In order that the record of musical shadings marked in pencil dots on the paper record may be indicated by the flashing of cues in their proper order, the pencil dots must be duplicated on the left hand side of the cylinder by means of steel pegs fitted into the lines of holes. There are fifteen of these lines of holes corresponding with the fifteen columns on the paper record.

The first scene, we remember, called for music at fortissimo, and it was indicated by a pencil mark in column No. 2. Accordingly, a metal peg is inserted, parallel with the mark, in the second line of holes. When all of the pegs, corresponding with the pencil marks, have been inserted, and the cylinder is again revolved, the cue signals in the red glass box flash in their proper order. The signals are caused to flash by the metal pegs which press small springs upward, causing electric connections to be made, delivering current to the corresponding signal lights.



As the film is reeled through the projection-machine an electrical contact is made with the cue-machine at every fifteenth revolution. The moving steel pegs push up contact springs and the proper signal is flashed to the orchestra. When all the reels have been shown, the cylinder in the orchestra pit will have made one complete revolution

The signaling apparatus is placed in the center of the orchestra where the leader stands. Signals are flashed on both back and front simultaneously. All signals are in the regular musical terms. In order that the leader and orchestra members shall not be caught unawares by a sudden change in music to fit a corresponding change on the screen, a warning signal is provided. This consists simply of a red light on top of the signal box. The method of controlling the warning light is the same as for the other cues. Organ, trumpet or drum can have separate signal lights attached to their music stands. With Mr. Lawton's electrical orchestra director it is possible to alter the music to fit a scene every five seconds. Few scenes are of such short duration as that

Ordering Meals Electrically in Quick Lunch Restaurants

EATING in quick-lunch restaurants amidst a babel of discordant sounds from crashing dishes and shouts from frenzied waiters is a torture about to be eliminated. An electrical system of ordering for lunchrooms, clubs, restaurants and hotels has been devised. When an order is given the waiter will go to one or more sending stations conveniently placed and there push a button which will operate an annunciator installed in the kitchen and tell the kitchen hands just what food is wanted.

The sending station consists of a metal panel carrying a number of electrical push-buttons. Over each button is a name-plate into which can be placed a celluloid strip on which is written the particular dish which the push-button is to represent.

From the sending stations cables are brought into the kitchen to form electrical connection between the push-buttons and the receiving station which is in the form of a cabinet, the front face of which contains as many electrically-operated indicators as there are push-buttons in each sending station. Each time the waiters press any of the buttons of the sending stations, the corresponding indicators in the kitchen register the number of orders for each dish, the indicators advancing one number each time the buttons are depressed.

Press the "Pork and Beans" button and the "Pork and Beans" light flashes up in the kitchen. Thus you can now order your own meal in a certain Chicago lunchroom, or a waiter can order it noiselessly

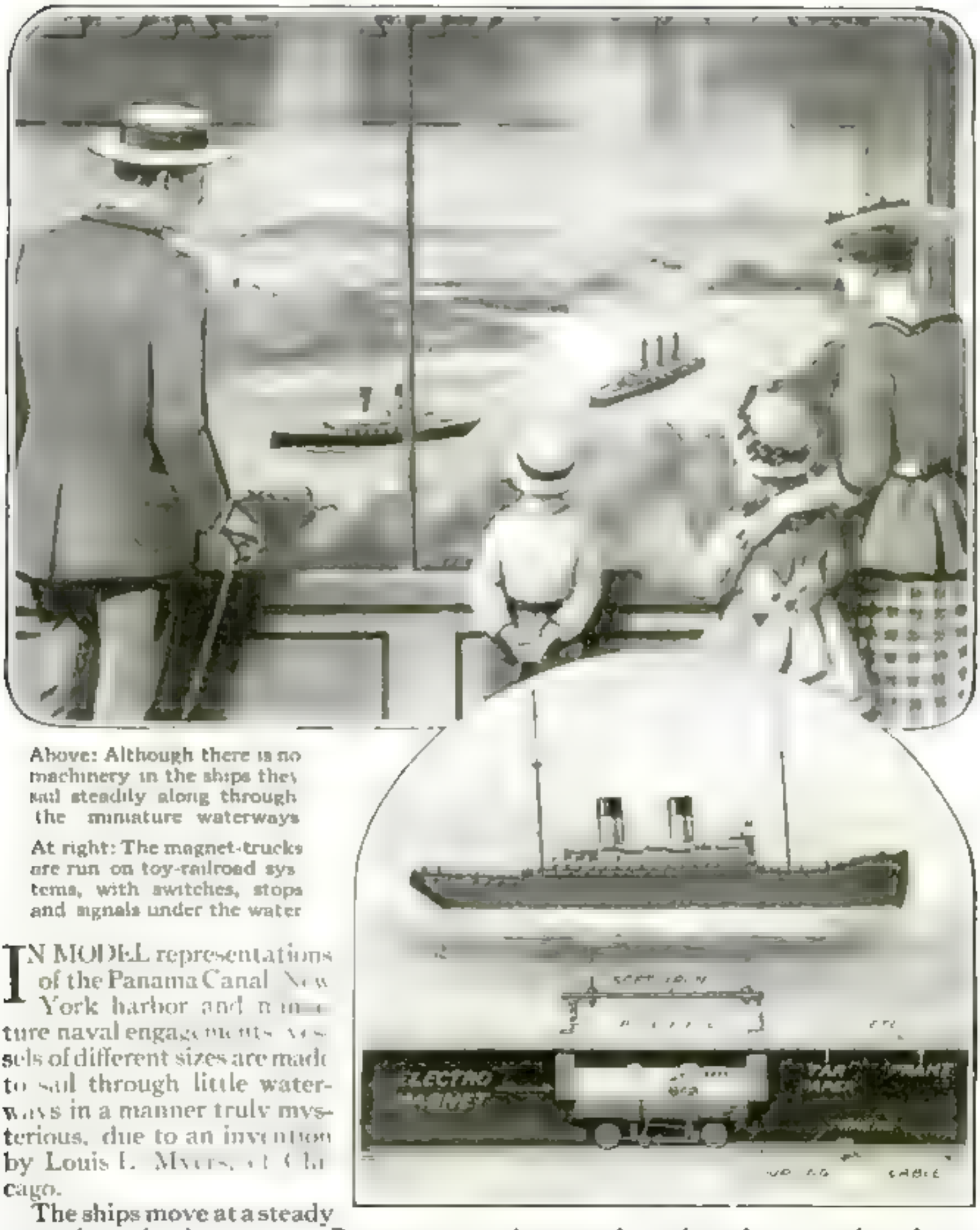
As long as any orders remain unfilled for any of the dishes indicated on the receiving station panel, a tiny red light flashes at the lower left-hand corner of each unit. As the orders are filled and passed out to the dining-room or lunchroom, the cooks press the corresponding push-buttons once for each dish, and the red light disappears.

The operating current is supplied by a storage battery. Two batteries are installed: while one is serving the system, the other is being charged.

As many as one hundred push-buttons can be arranged on a panel of a sending station where the list of dishes on the menu is very varied and extensive.

Miniature Magnet-Propeled Ships

The mysteries of window attractions explained



Above: Although there is no machinery in the ships they sail steadily along through the miniature waterways

At right: The magnet-trucks are run on toy-railroad systems, with switches, stops and signals under the water

IN MODEL representations of the Panama Canal New York harbor and miniature naval engagements vessels of different sizes are made to sail through little waterways in a manner truly mysterious, due to an invention by Louis L. Myers, of Chicago.

The ships move at a steady rate through the water. But as you watch them closely, you notice that the propellers are not moving. What, then, drives the ships? A soft, iron strip which hangs several inches below the hull has a downward continuation at each end, terminating in pole-pieces which have connection with an electro-magnet running on tracks below the tar-paper-and-concrete "river bed."

Teaching English Girls the Art of Milking

"WHAT are you doing, my pretty maid?" "I'm practicing milking, Sir," she said—or at least that is what the girl in the photograph might answer if you put the question to her in that way. She is one of a number of would-be-dairy-maids who are endeavoring to solve the problem of the labor-shortage in Essex, England. The instruction classes are under the direction of the Women's War Agricultural Association, and many women and girls, some of them less than twelve years old, are learning the fine points of the art of milking without inconveniencing the cow.

"What are you doing, my pretty maid?" "I'm practicing milking, Sir," she said

The device employed consists of a frame supporting a rubber bag which resembles the udder of a cow. The milk or substitute liquid is poured into the bag, from which it is coaxed by just the right pressure applied in just the right way.

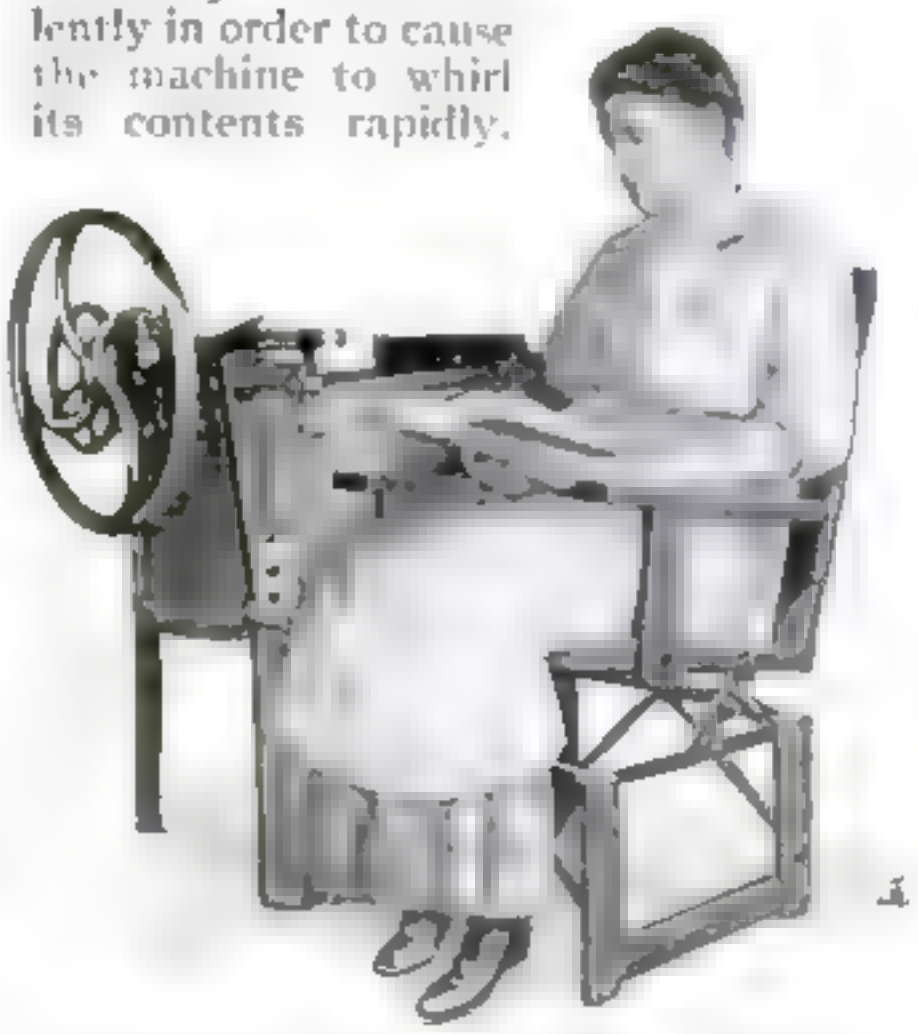
An Inventor Invents Because He Can't Help It

"ONE thing stands out conspicuously: the race of contrivers and inventors obeys an inborn and irresistible impulse," states F. W. Taussig, Professor of Economics in Harvard University. ("Inventors and Money-Makers." The Macmillan Company.) "Cartwright was in difficulties almost all his life; yet he never relaxed his interest in any and every sort of mechanical device. Edison made fortunes and lost them again; but throughout he remained the same amazing and persistent contriver. And it would seem that no satisfaction from pecuniary success or worldly recognition equals the absorbed interest of trial, experiment, novel problems, happy solutions."

Doing the Family Washing in Your Rocking-Chair

UNDOUBTEDLY the washing-machine has proved to be one of the greatest friends which the erstwhile household drudge has found. Where there is an electric motor to run the machine it has reduced the labor of laundering to a minimum. But there is still a certain amount of tedious labor in connection with the one which is run by hand-power.

The illustration below shows an invention by A. W. Wolfskill, of Adamstown, Pa., which utilizes for the purpose the energy expended in rocking to and fro in a rocking-chair. Two springs under the seat of the chair, one at the front and the other at the back, are connected with the machine in such a way that the slightest movement of the chair is communicated to the tub. It is not necessary to rock violently in order to cause the machine to whirl its contents rapidly.



Two springs under the seat of the chair communicate the motion to the washing-machine

Watching Dishonest Employees with the Aid of Mirrors

A NOVEL fraud-detector invented by Henry Muller, of Philadelphia, Pa., enables the proprietor of a business, seated at his desk in another room entirely separated from the room in which his customers are being served, not only to observe the actions of his employees but to have before him at all times an accurate reproduction of the operation of the cash register.

If a dishonest employee fails to ring up the proper amount on the cash register, the proprietor in his room above can instantly detect the fraud. In brief, the invention calls for a cash register with special indicators which project upward, a mirror in a clock or other enclosure on the wall near the cash register, and a tube running through the floor to the proprietor's desk, upon which is a glass through which the reflections of the mirror on the wall of the room below are visible.

The proprietor, watching the glass on the desk before him, discovers that an employee is not ringing up the correct amount on the cash register

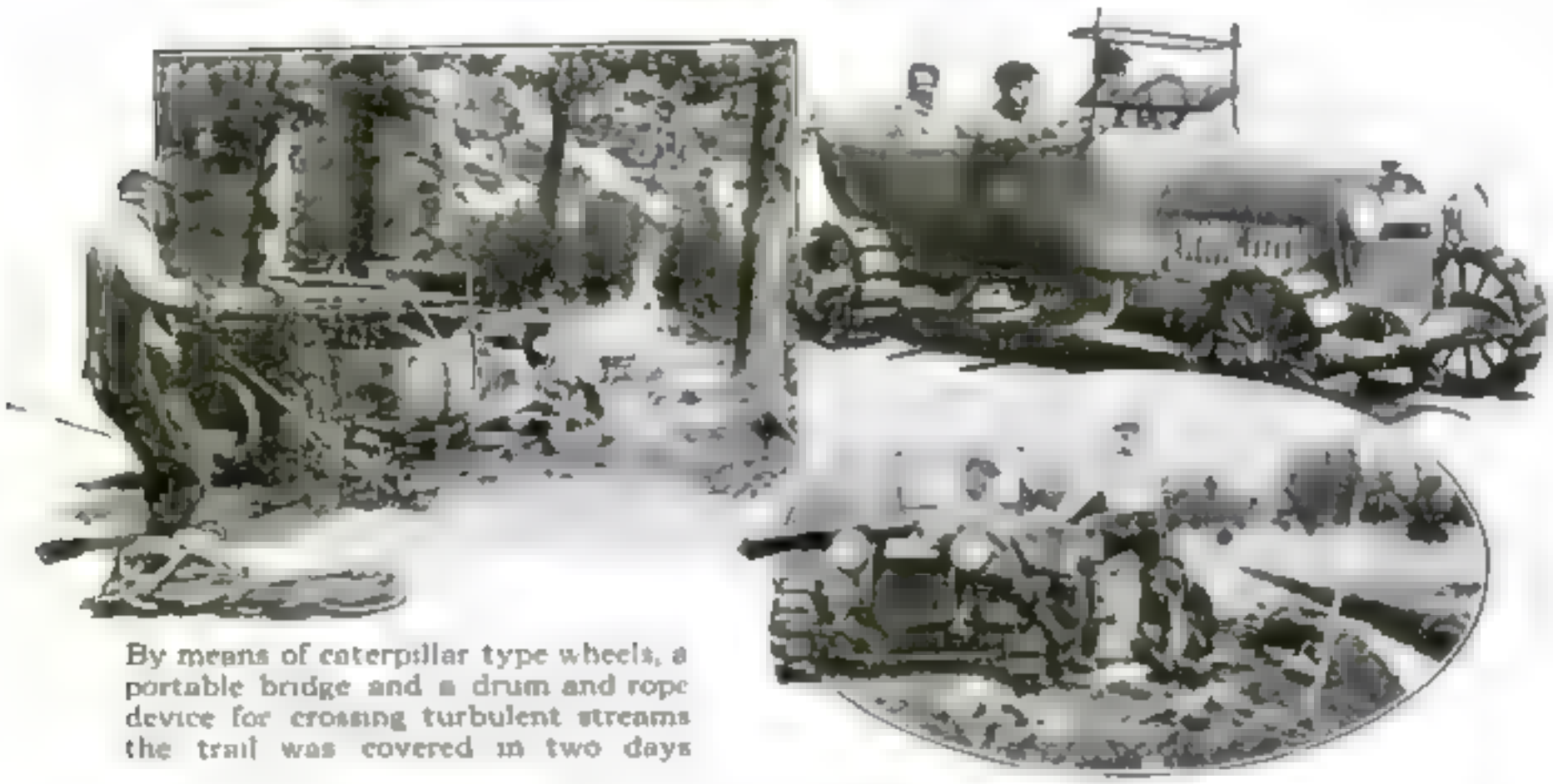
The tube arranged in the position shown in the accompanying illustration would not excite the suspicion of employees. The indicators which move upward when the keys on the cash register are depressed to show the amount purchased are a part of the drawer. Each indicator is provided with a number. If ten cents is deposited the numeral ten moves upward to a certain angle and is reflected by the mirror on the wall.

The Inventor of the Steam Engine Was Interested in Gim-Cracks

"WATT was interested in a quantity of inventions and devices," writes F. W. Taussig, Professor of Economics in Harvard University. ("Inventors and Money-Makers," The Macmillan Company.) "Among them may be mentioned a new kind of clock which, to quote Watt's own language 'is to be ranked in mechanics as riddles and rebusses are ranked in poetry.' Other "gim-cracks" were a micrometer; a drawing machine; a copying machine for letters, prototype of the copying devices now so long in use; a machine for drying linen and muslin by steam; one for getting illuminating gas from coal; a new kind of oil lamp long manufactured at the Soho works; and a smoke-consuming device, on the down-draft principle. Last, but not least significant, was a machine for copying (reproducing) sculpture, which he himself termed a 'hobby-horse,' and which seems to have amused and indeed absorbed him for the last twenty years of his life (from 1791 to 1819). Long after he was prosperous and honored, the old man spent much time in his garret, hot or cold, over this machine; he was sure it would succeed. He spoke of it as the 'diminishing machine.' The garret in which he worked at it was long preserved by his descendants."

Breaking a Mountain Trail

Wheels had to be taken off and caterpillar treads substituted, and bridges had to be built



By means of caterpillar type wheels, a portable bridge and a drum and rope device for crossing turbulent streams the trail was covered in two days

THE one annual sporting event in Southern California which is of unusual interest is breaking the trail into Big Bear Valley, a fishing and hunting resort on top of the San Bernardino Mountains, at an elevation of seven thousand feet. For years the automobile men and enthusiasts have contested for the honor of being the first to make the trip after the opening of the new year. The rivalry between these men has been made more keen since a sporting-goods house offered a yearly cup to the automobile and crew which should be the first to cross the divide.

Every winter the Big Bear Valley section is visited by severe rain, hail and snowstorms. Cloudbursts are numerous and there are several months during which the country around the tops of the mountains is literally frozen-up. During these periods it is impossible to reach the top by machine, and it is almost worth the life of a person to tackle the trip on foot. Before the winter is very old the trails and roads leading to the summit are made practically impassable by washouts, landslides and fallen trees.

The crew piloting the last successful car converted their wheels into the caterpillar type. The aim of the crew was to proceed as far as possible on the inflated tires and when the going became too hard on the rubber to change to the caterpillar wheels. When the rubber tires were taken off they were hung to tree branches to await the party's return.

A portable bridge was carried for crossing streams, but there was one place where the temporary bridge was useless. This was a thirty-foot stream of swiftly running water. The men cut down a pair of large trees on the nearby bank, letting them fall across the stream so that they reached from bank to bank. They were then drawn together so that the caterpillar wheels came on either side of them, the axles being the only parts of the car which touched the logs. Strong ropes were fastened to trees on the farther side of the stream, the other ends being turned several times around drums fastened to the rear wheels. When the motor was started the drums turned and the machine simply dragged itself across the log upon its axles. Many times this drum-and-rope idea was brought into play when the car became stuck. Other crews that started on the trail did not reach the half-way house.

"Shooting" Birds with a Camera

Making intimate pictures of bird-life

At right: A flock of wild ducks photographed by the gun camera without disturbing the birds

Below: A great blue heron unconsciously posing before the distant gun-camera

Above: Birds in flight are as easily caught by the camera as those at rest. At f The great focal length used increases the size of the image secured

The difficulty of getting close enough to the birds to secure such size or detail has been overcome by Stanley Clisby Arthur, state ornithologist of Louisiana, through the use of a "gun-camera," which consists of an ordinary reflecting camera with the usual bellows extension, mounted on a carriage with wheels. The bellows is supplemented with a tube to admit the use of long-focus lenses.

In the camera illustrated the lens is recessed in the far end of the tube so as to have the benefit of a lens-hood when working against the sun or light, and focusing is accomplished in the ordinary way by the milled head.

The device when set up is perfectly rigid and enables Mr. Arthur to "pick off" birds at any height or in flight.

TO secure photographs of bird life so that the plumage detail, identification marks and such matters dear to the heart of the trained bird student or to those who merely delight in viewing pictures of nature, a large image of the object photographed must be secured.

Hold a microphone against your back and it will pick up the sound of your voice

Hearing Your Voice Through Your Bones

A FRENCH specialist, Dr. Jules Glover, has devised a method of picking up the vibrations of the voice in the bones and tissues of the body. He employs a galvanometer—in other words, a sensitive current-measuring device—in the circuit, with which is a microphone or sound-detector, the primary of an induction coil, and a battery connected with a voltameter. The microphone is placed against the subject's body, so that it can be affected only after the voice has vibrated through a dense layer of bones and muscle. The voice is not actually heard, but rather visualized, since the galvanometer-needle swings out of its course as soon as the current flowing through the circuit is changed in the slightest. The current is so changed because the vibrations affect the microphone in the circuit from moment to moment. By including telephone receivers in the circuit of the secondary of the coil, and fastening them to his ears, Dr. Glover also hears the sounds passing through the body.

Dr. Glover claims that his system renders it possible to take a patient's pulse far more accurately than is possible with the hand alone. He can count the beats both as they appear as fluctuations of the galvanometer-needle or as rhythmic clicks in the telephone receivers. Variations undetected by the hand are immediately observed. In this case the microphone is employed as a transmitter.

A Motor-Wheel for the Railroad Velocipede

RIDING the rails on a velocipede propeled by a motor-wheel, the trackman traveling to make repairs has a special car of his own just as the railroad president has. For a good many years the trackman has had his velocipede and has hand-pumped it up hill and down dale until all novelty connected with the vehicle has long since been forgotten. With the introduction of the motor-wheel, however, he is again in the limelight. He can recline in his seat, operate the motor, and sail over the tracks without any expenditure of energy.

The motor-wheel can be attached to the velocipede and taken off without making any alterations. A casting which fits between the two lower rails of the velocipede serves as the connecting unit. It holds the motor-wheel securely in place, so that it cannot move either to the right or left, but stays constantly on the balls of the rail. The attachments permit of the free moving of the wheel.

The driver can recline in his seat, operate the motor and speed over the tracks without expending energy

The "Permanent Wave" of a Woman's Hair and Its Secret

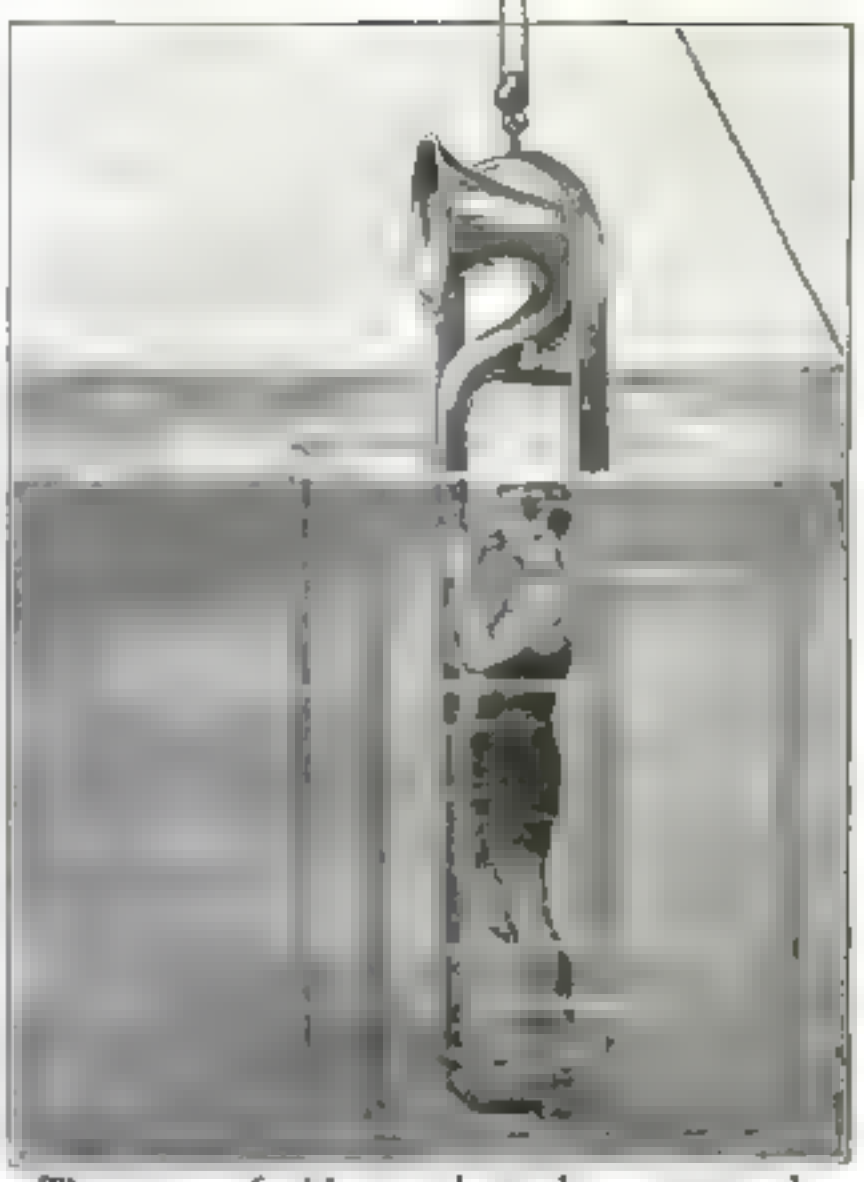
A NEW process for making a permanent wave in feminine tresses has been invented by a New York man.

First of all the hair is divided into a greater number of strands than has been the usual practice. The part of each strand nearest the head is wrapped round a small curling rod. As it is wrapped the hair is slightly twisted. The part of the hair which has been waved previously is allowed to fall free.

The strands coiled around the curlers are treated with a supersaturated saline solution in the form of paste. This saturated coiled portion of the hair is then inclosed in a wrapping and heated by encircling the coiled hair with a suitable heater.

A temperature of 800 degrees is maintained for about twenty minutes. Then the heat is turned off for four minutes, and turned on again for four minutes. After the hair has cooled it is taken out of the coils and washed.

The saturated strands of hair are wrapped in flannel and heated twice by electricity



The sirens of old may have been more alluring but certainly no more mysterious

The Lure of the Lorelei Minus the Siren

THE song of the sirens has long been stilled. The flowing deep has lost its sweet-voiced, seductive interpreters and the wild waves whisper enigmas. Instead, the voice of the saxophone, the bugle or the bass horn may be made to steal along the surface of the waters.

The principle of the invention which makes this possible is merely the submersion of a watertight compartment with vents for air and a horn or other vent connected, through which music may be sung or played for the amusement of an audience.

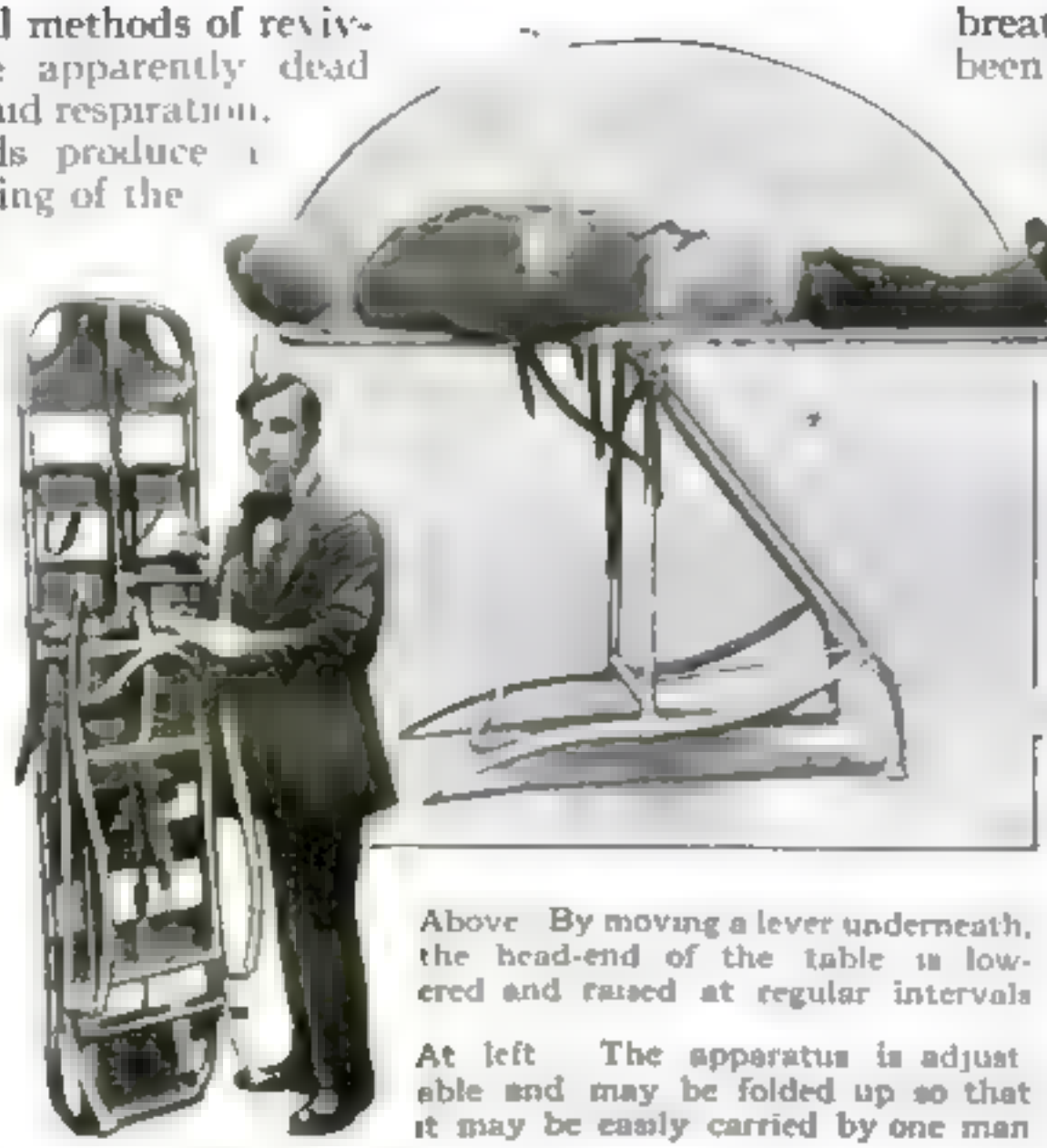
The water-tight compartment is a box of glass with a steel frame—or, it may be a leak-proof barrel with a superstructure for supporting the instrument. A block-and-tackle is attached so that it can be immersed and raised at will. The idea presented is open to variation and many amusing effects might be obtained by the use of concealed vents in the place of the conspicuous horn which is shown in the illustration.

Resuscitating the Drowned

A first-aid tilting machine

THE usual methods of reviving the apparently dead aim to aid respiration. These methods produce a rhythmical filling of the chest with air. Unfortunately they require the aid of several well-trained attendants for a considerable time, and such aid may not always be at hand.

The apparatus shown in the accompanying illustrations, which is the invention of Dr. L. Lewin, of Germany, is said to attain the desired end with greater ease and certainty. It consists of an adjustable table or couch on which the person to be revived is placed and put through the different desired positions with the aid of only one attendant. The folding table is easily transported and is so constructed that the head or foot-end can be raised or lowered until it forms a decided angle with the horizontal position of the couch. The patient, say one to be revived from drowning, is strapped to the table by a bandage. By moving a lever carrying a pawl the head-end is lowered to an angle of ninety degrees with the horizontal, the patient being thus stood on his head. This causes the water collected in the lungs to flow out of the nose and mouth, both as a result of the law of gravity and also because the falling of the intestines drives the diaphragm forward and produces a strong compression of the chest. After a passive breathing out has been produced during the ten to fifteen seconds of this position the table is swung towards the opposite side so that the patient is brought into a nearly upright position. This change brings about an expansion of the chest, the result of its elasticity and the sinking into the natural position of the intestines and diaphragm. Both of these movements can be repeated several times a minute, thus causing a succession of breathings in and out. In addition to this, if the heart action is poor the blood is driven to the different parts of the body by gravity in the changes of position.



Above By moving a lever underneath, the head-end of the table is lowered and raised at regular intervals

At left The apparatus is adjustable and may be folded up so that it may be easily carried by one man

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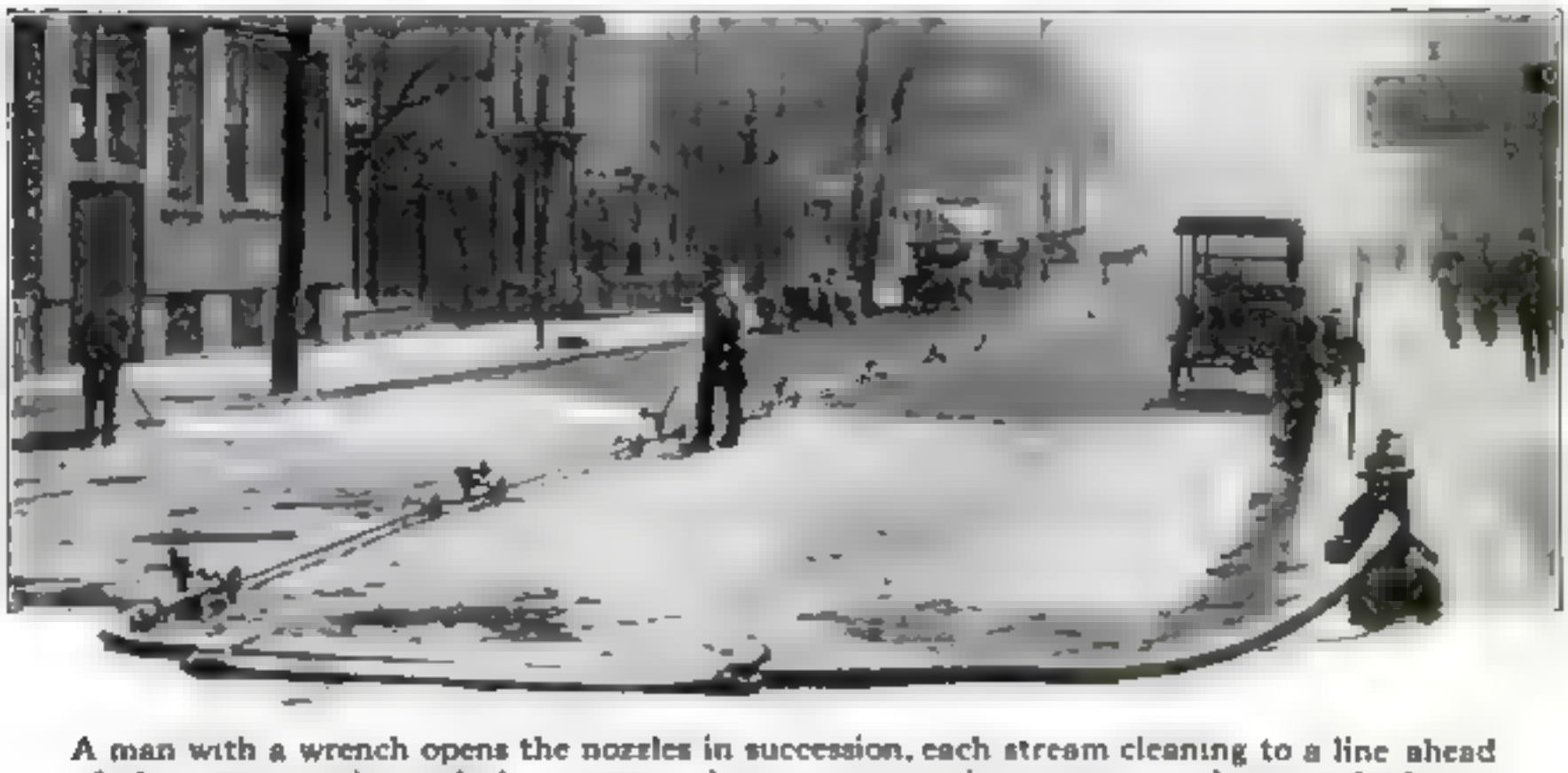
Nature and Not Cannons the Real Cause of Rainfall

WHY does rain often follow great battles? Cannonading has nothing to do with it. The belief that rain commonly follows battles antedates the invention of gunpowder. In temperate latitudes rain occurs normally, on an average, every three or four days, or, in some regions, as often as every other day. The movements of troops that precede a battle are rendered difficult or impossible by wet weather and muddy roads. Hence the preliminaries of battle are carried out during intervals of fair weather.



A man with a wrench opens the nozzles in succession, each stream cleaning to a line ahead of the next nozzle until the operator has gone over the entire area between hydrants

Flushing Streets with Streams from Movable Pipe-Lines

DIFFERING entirely from all previous types of street-flushing apparatus, a simple device recently put on the market consists of a jointed line of piping with valves at regular intervals, the whole being placed in the center of the street from hydrant to hydrant and the flushing accomplished by turning on each nozzle in succession. The pipe line is made up of sixteen-foot sections, each mounted on two wheels at each end and connected with the next section by means of short lengths of rubber hose. Each unit has a swinging valve connection, which can be turned in any direction.

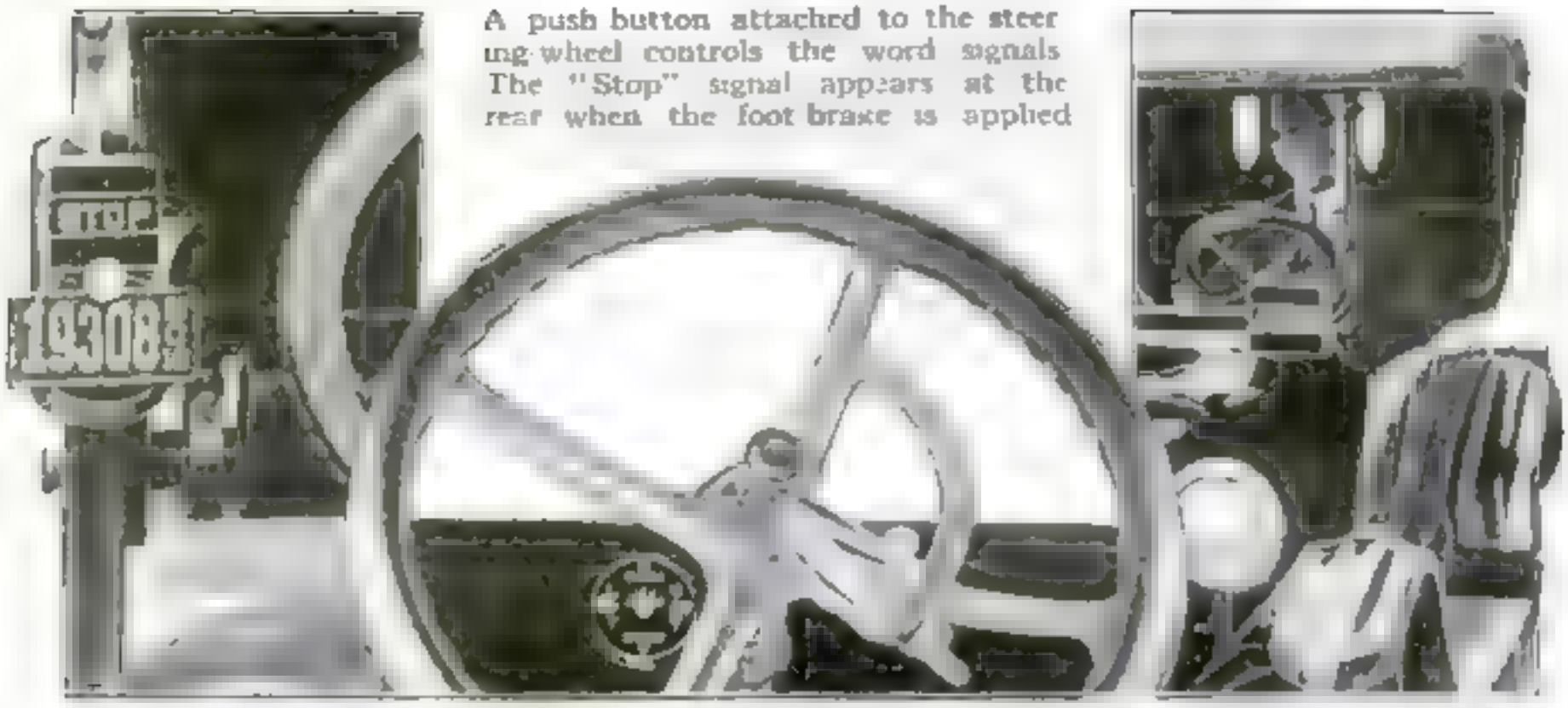
One end of the line is attached to the nearest street-hydrant.

The Northern Logger Is the Nerviest of Our Steeplejacks

ONE has only to go to the depths of the great wooded districts of Oregon and meet the logger in his native haunts to recognize in him all the qualities which go to make up a nervy steeple-climber. He thinks nothing of doing an ordinary steeplejack's job before breakfast and then dogging falling trees and setting off dynamite blasts until the supper bell rings.

The accompanying photograph shows a logger in the act of oiling two large blocks. He was hoisted to his dizzy position by a donkey engine, and as he sat there, straddling two thin steel cables, he was so much at home that he smoked his pipe. The large pole is a gin-pole, erected to lift the logs

The lumberman calmly smokes his pipe as he oils the blocks at the top of the swaying pole



A push button attached to the steering wheel controls the word signals The "Stop" signal appears at the rear when the foot brake is applied

Automatic Word Signals for Automobiles

DIFFERING from other forms of traffic signals fitted on automobiles in that the direction the car is about to take is indicated at both front and rear and that words are used to denote these directions, the novel type shown in the accompanying illustrations consists of two metal boxes, one on the dash and the other at the rear above the registration plate. Each of these boxes contains an opening before which the words "Ahead," "Right," "Left," "Back" and "Stop" can be displayed at will by means of an electric push-button control attached to the steering-wheel The words are cut into an endless roll in each box, the movement of the roll being electrically controlled and illumin ted at night. Th control has a button for each of the words used. The signal "Ahead" is always displayed to indicate that movement but is changed as desired by pushing one of the other buttons. The control buttons are interlocking, so that only one signal can be shown at a time. The signal "Stop" is wired up to the foot-brake, so that it appears at the rear whenever the foot-brake is applied. It automatically disappears as soon as the foot brake is released.

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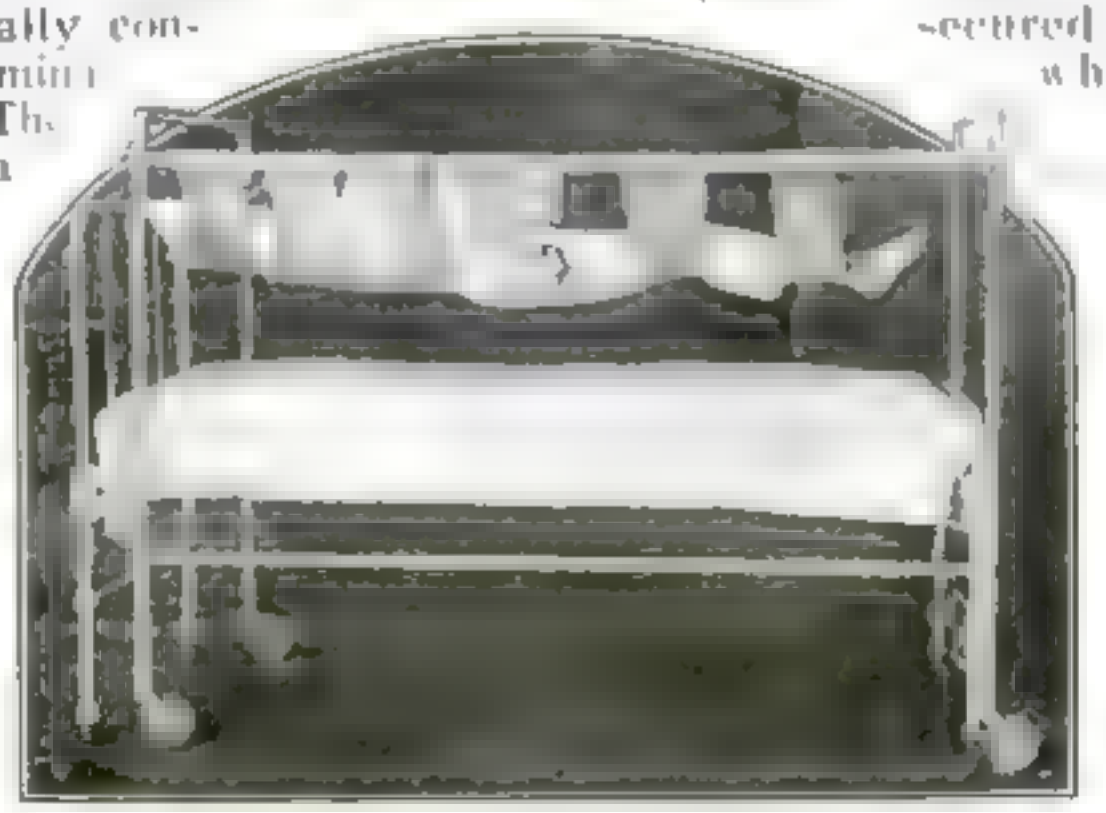
Lifting Invalids with a Minimum of Discomfort

THE lifter illustrated is made a little wider than the ordinary hospital bed so that it may be placed in position by being rolled up to the bed from the foot, the sides of the lifter just escaping the sides of the bed. It is an easy matter to place the supporting straps under the patient. When the straps are secured the frame to which they are attached may be lifted by means of a lever. In handling fever patients who require frequent baths the device is of great service. It may also be used for transporting patients from one room to another.



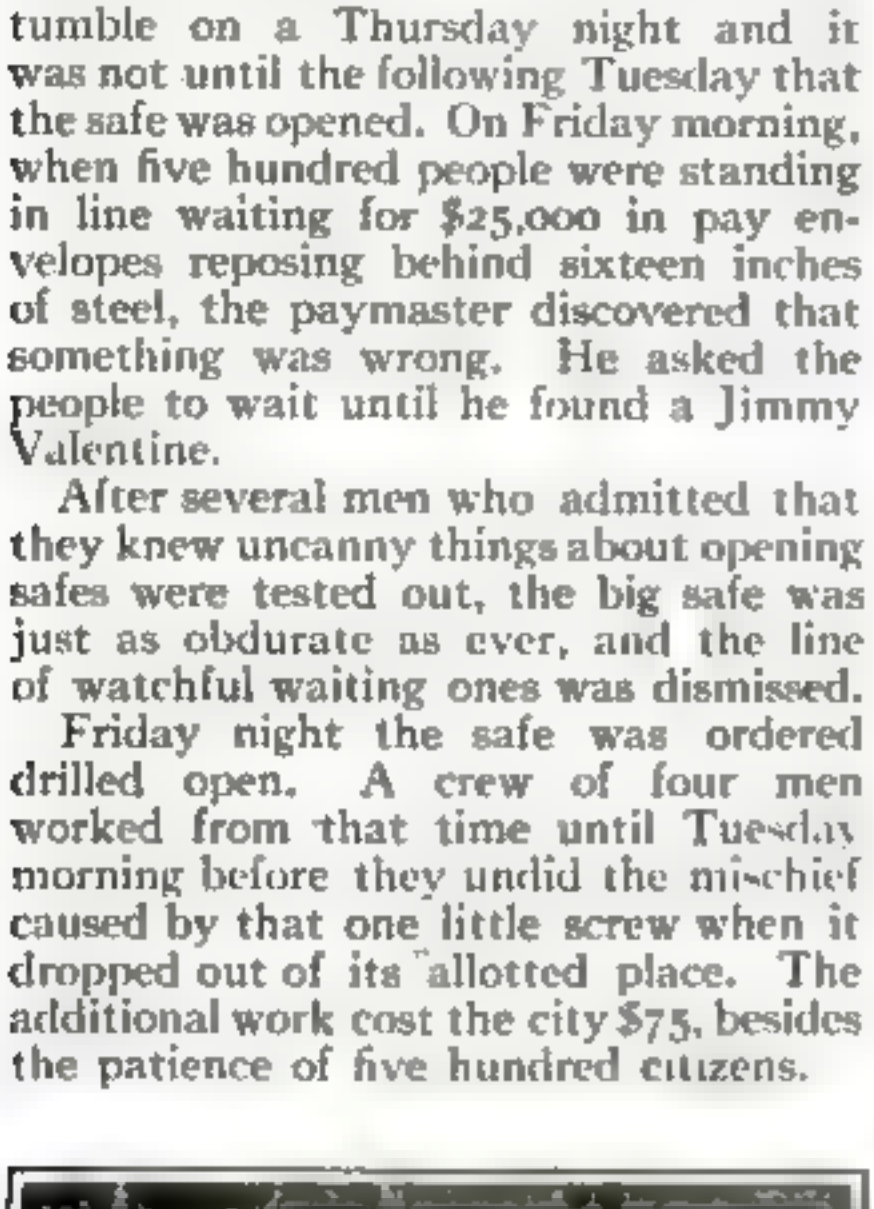
An invalid being raised from his bed by means of the mechanical lifter to allow a change of the linen

How a Tiny Screw Held Up a Great City's Business

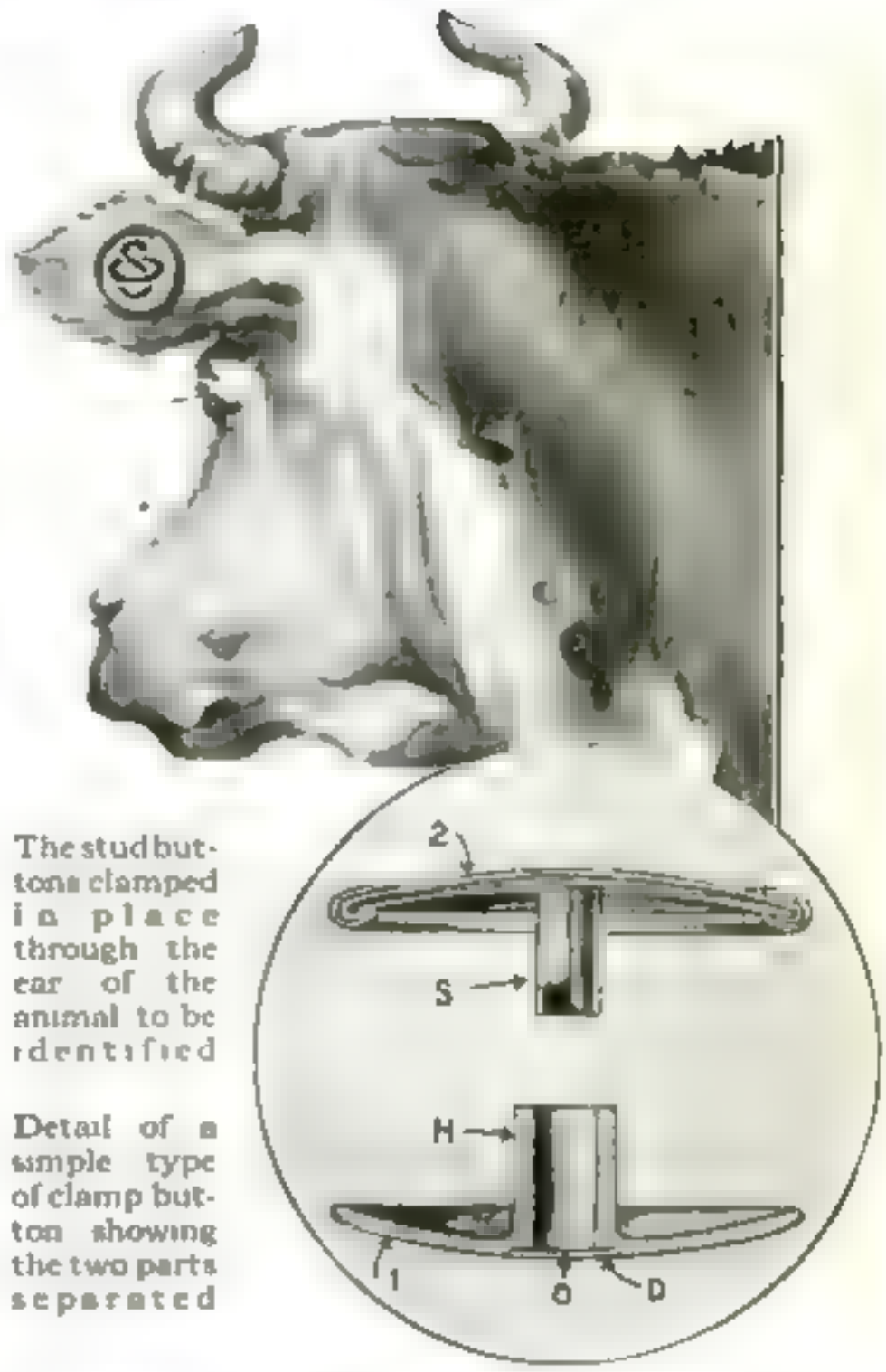
A DIMINUTIVE screw worked loose in one of the big steel safes in the treasury department of Cincinnati recently, and dropped into the mechanism operating the combination. Thereafter there was trouble. The screw took its tumble on a Thursday night and it was not until the following Tuesday that the safe was opened. On Friday morning, when five hundred people were standing in line waiting for $25,000 in pay envelopes reposing behind sixteen inches of steel, the paymaster discovered that something was wrong. He asked the people to wait until he found a Jimmy Valentine.

After several men who admitted that they knew uncanny things about opening safes were tested out, the big safe was just as obdurate as ever, and the line of watchful waiting ones was dismissed.

Friday night the safe was ordered drilled open. A crew of four men worked from that time until Tuesday morning before they undid the mischief caused by that one little screw when it dropped out of its allotted place. The additional work cost the city $75, besides the patience of five hundred citizens.



A screw fell into the combination of the safe and held up the Cincinnati treasury five days, defying skilled safe-openers



The stud buttons clamped in place through the ear of the animal to be identified

Detail of a simple type of clamp button showing the two parts separated

Branding Animals with a Clamp-Button Monogram

MARKING of animals for the purpose of identification has long been accomplished by means of the branding iron. The branding of stable stock, however, means a marred coat. A new method of marking with metal buttons offers several advantages. The buttons are clamped through the ear by means of a cylinder and split shank.

Animal stealing would be rendered unprofitable, for the removal of a button, or its defacement, would be extremely difficult. The detail drawing shows a simple type and design of clamp-button. The stud 1 has a short cylinder-sleeve *H* into which the split shank *S* of stud 2 passes—the long end of the shank projecting through cylinder-end *O* is spread outwardly by pincer pressure, the spread ends fitting neatly into the depression *D* in the surface of stud 1 thus clamping on the stud buttons.

The native boys climb with the agility of monkeys, using their hands and feet

How West Indians Walk Up Coconut-Palm Trees

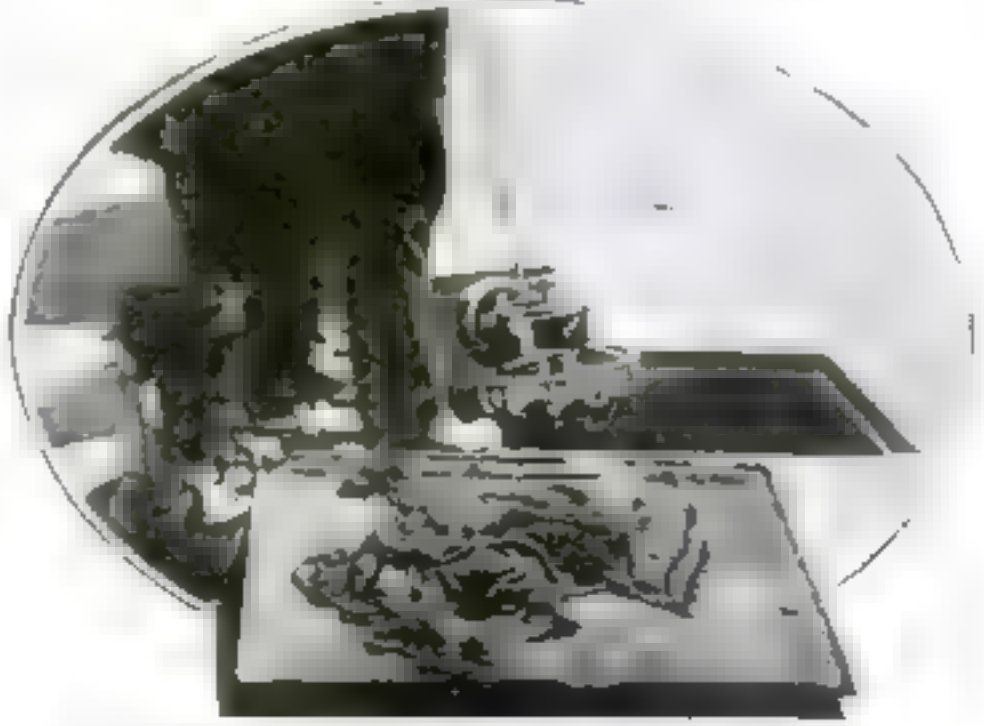
THE visitor to the West Indies often looks with longing at the great bunches of coconuts swinging at the summits of the lofty palm trees and quite out of reach of ordinary mortals. You may think that the natives wait until the nuts ripen and fall before gathering them, or you may remember childhood tales of petulant monkeys throwing the nuts at human beings below. But if you express a desire for a few coconuts and back up your request with a few pennies, you will discover that the colored boys neither wait for the nuts to fall nor depend on monkeys to throw them down. Instead the nimble darkeys will climb up the smoothest and tallest trees to gather the nuts, for they are every bit the equals of monkeys in this respect.

Instead of "shinnying" up as northern boys climb our trees or hugging the trunk with arms and legs, the West Indian negroes actually *walk* up the trees. Clasping the smooth trunk with their hands and placing the soles of their feet against it they ascend the trees without the least difficulty and descend in the same manner.

So prehensile can the toes become that West Indian sailors climb ropes and rigging as they do palm trees; it is not an uncommon sight to see a black seaman walk up the polished mast of his sloop.

Manhole Ventilated with Electric Fan to Cool Men Below

WORKMEN employed in the conduits of a Los Angeles electric company are enabled to work in comfort while underground by the use of an electric fan for ventilation. The manhole is protected by a portable railed enclosure, to keep any careless motorist from driving into it, and at the base of the railing is set an ordinary electric fan, so arranged that the blades drive the air straight down. This affords a cool breeze that reaches the workman in the hot and stuffy cell below the pavement and adds a great deal to his comfort.



The blades of the electric fan suspended in the manhole drive the air currents straight down

What Becomes of Old Army Rifles?

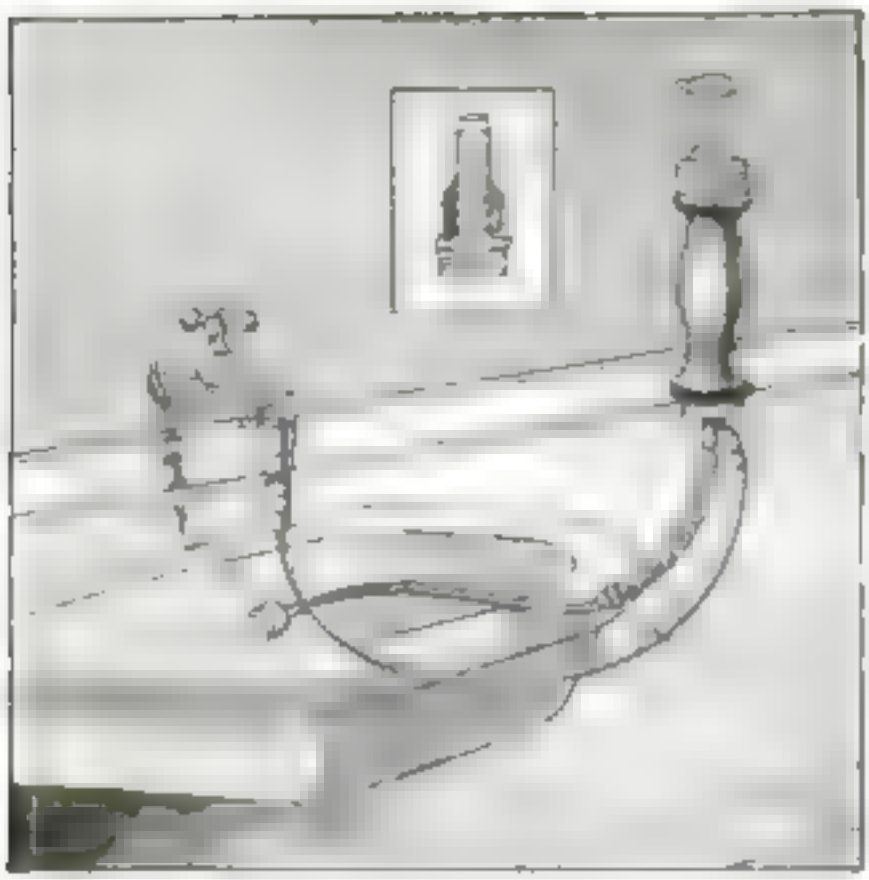
Instead of beating swords and guns into pruning-hooks and ploughshares, the Government sells them to motion-picture companies

WHENEVER the army and navy officials find that they have on hand a considerable quantity of supplies which for some reason are no longer usable, they condemn the equipment, arrange it in various lots, and call for sealed bids. These supplies usually include a great variety of articles ranging from corkscrews to cannons, from sailors' shirts to submarines, from a few hundred mess pans to millions of cartridges—a miscellaneous and heterogeneous stock, which only a daring man would buy and only a genius could utilize.

Methods of marketing army and navy goods are interesting. In the past, military schools have been among the largest consumers; but they must now give first place to motion-picture companies. There is practically no end to the usable material which these concerns can find in discarded government military paraphernalia.

Swords, guns and bayonets are worked up into a variety of ornamental designs

Other kinds of equipment are transformed into useful and artistic objects. Coats of arms, hat and cap insignia, and other metal decorations placed on wood plaques make attractive curios. One hundred thousand helmet eagles have been used in this way. Bullets removed from cartridges and provided with proper bases are neat and serviceable paper weights. Short swords, cutlasses, etc., can be utilized as bread and meat knives. Ship lanterns fitted with electric connections make artistic hall, porch, and gate lamps. And swords, guns, and bayonets are worked up into a variety of pieces. The most pretentious of these are the three-light candelabra, the smoking-stand, and the hall tree illustrated. The candelabra is made of three bayonets gracefully curled and fastened together at the base and fitted at the top with three candle-brackets. The staff of the smoking-stand is a nickel-plated rifle-barrel, while the base and the ash-tray are made out of belt-clasps, buckles, stirrup-cups, and other metal odds and ends all melted together and molded into artistic forms. The hall tree is a real work of art. By removing three screws the rifle can be released from the frame to be used again.



The current of water through the vibrator is interrupted ten times a second with this apparatus

Making the Water from a Faucet Vibrate Fifteen Times a Second

IF water from a water-supply conduit is introduced under pressure in the outer space, or tube, of a double cylinder perforated with fine holes at its rear end, the water is forced to flow out through the fine holes. If a rubber membrane is stretched across the holes it will vibrate because of the repeated upward pressure of the outflowing water and the alternate action of suction.

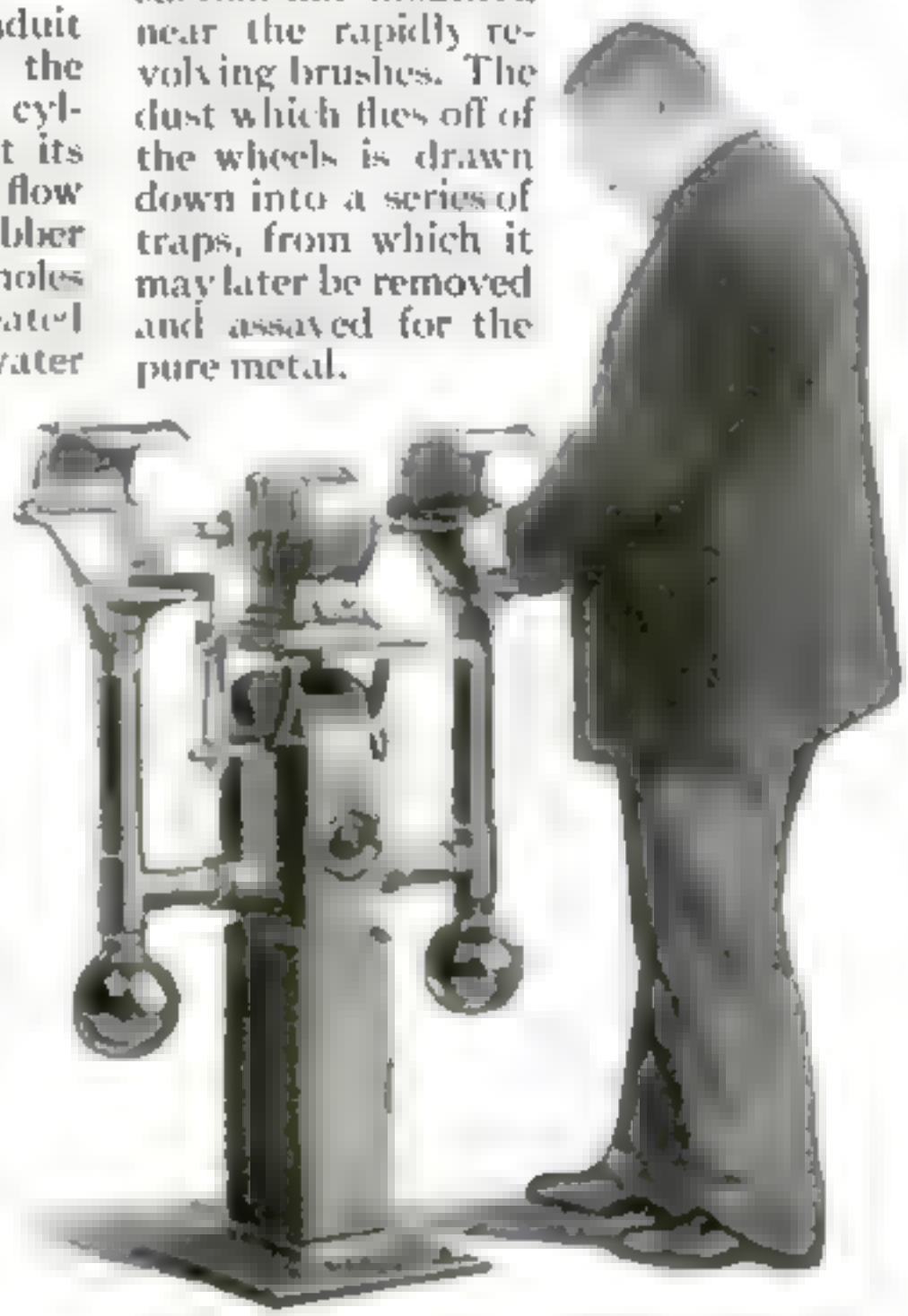
The illustration shows a vibration apparatus embodying the principle of an interrupter in which the stress transmitted upon the rubber membrane is obtained in a simple manner. In a metal screw-ring is a rubber membrane and below it is a rubber ring. When the metal ring is screwed upon the top part the rubber membrane is stretched across the cone, and on opening the water cock it is subjected to rapid vibrations. In case the vibrations of the membrane are to be transmitted to a piston, the ring is removed by unscrewing and a fixture is used instead. This consists of the same metal ring and in addition a piston held under tension by means of a spring in the cylinder. When the membrane is subjected to the up-and-down movement it pushes the piston upward. The piston is then depressed by the spring and again driven upward by the membrane.

One peculiarity of the water-pressure interrupter is that in the expulsion of water ten to fifteen interruptions of the current occur every second, instead of a constant flow. For instance, if the out-flowing water is directed into a bottle the water current issuing jerkily will act more effectively in cleaning the bottle than would the ordinary flowing current of water.

Saving Gold and Silver on the Vacuum-Cleaner Principle

STARTLING amounts of metal are removed from gold and silver articles by the simple work of polishing. In the case of jewelers who do much polishing work during a year, the loss in gold and silver is great.

A new form of polishing-machine aims to conserve the dust by means of a suction-fan mounted near the rapidly revolving brushes. The dust which flies off of the wheels is drawn down into a series of traps, from which it may later be removed and assayed for the pure metal.



A suction-fan on a jeweler's polishing machine draws all the gold and silver dust into a trap

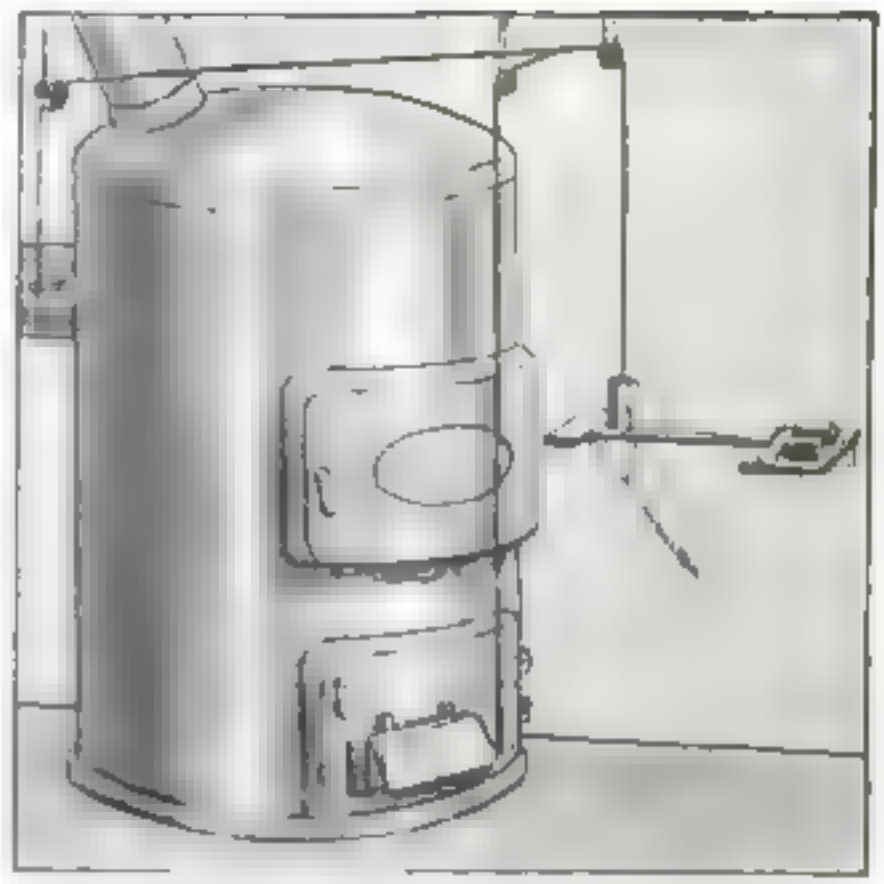
A Pipe Filler Which Takes the Place of the Smoker's Fingers

THE fastidious smoker who does not wish to stain his fingers can stuff his pipe with an instrument invented by Arthur A. Hauerbach and Hugh G. Allan, of Stockton, California.

The stuffer measures a pipeful of tobacco in the tobacco-pouch or jar and then forces it into the bowl of the pipe without losing a particle. It consists of a tubular handle provided with a long slot near one end and a cylindrical bowl at the other. Within the bowl is a plunger which is fastened to a piston terminating in a finger at the top of the tubular handle, as shown in the accompanying illustration.

When the pipe is to be filled, the bowl-end of the stuffer is inserted into the jar of tobacco and turned until the bowl is packed tight. Then the stuffer is fitted into the bowl of the pipe. By pressing down the finger the plunger forces the tobacco into the pipe in a neat and compact mold. A spiral spring in the tubular handle instantly returns the various parts to their normal position when the mechanical finger is released.

The filler presses the tobacco into the pipe in a compact mold without staining the hands



A weight supported by a strip of wood is attached to the damper and draughts

Reducing the Furnace Man to a Mere Push-Button

FALLING down the cellar stairs in an attempt to get at the furnace to open the draughts on one of these blustering, cold mornings is not a wise or a necessary thing to do. By installing an apparatus such as is described here, you can stay in your warm bed and set the furnace to heating the house by merely pressing a push-button at your side. Or if you are given to over-sleeping, your alarm clock will perform the same service for you.

The apparatus for regulating the furnace consists of a weight attached by ropes to the damper and draughts, a light strip of wood to hold the weight, two magnets, an armature, and pulleys to lessen the rope-friction. The strip of wood which holds the weight is wide at one end and pointed at the other, as shown in the illustration. The pointed end rests on a heavy strip of soft iron which moves on two tin rails. When the push-button in the bedroom is pressed, a circuit is closed and the two magnets draw the piece of iron, or the armature, from under the supporting strip of wood, causing the weight to fall down and pull open the draughts.

An alarm clock may be used to take the place of the push-button. The clock can be set to complete a circuit at a certain hour and to open the furnace draughts in the way illustrated.

A glass of water may be heated almost instantly by immersing the cylinder in the water

A Magic Wand Which Changes Cold Water Into Hot Almost Instantly

THE variety of uses to which the little immersion-heater shown in the illustration may be put will insure its popularity. It is a cylindrical tube about seven inches in length, having a flexible cord with a plug at the end which may be attached to any electric-light socket. Inside of the nickel case microhm resistance wire is wound about a mica coil, and when current is passed through this wire a white heat is obtained in a few seconds, so that it heats a small vessel of water almost instantaneously. The cylinder is immersed in the shaving mug, for instance, and in less than a minute the water is ready for use. A few seconds longer and it will boil. In warming the baby's bottle, however, it is best to heat a larger vessel of water, and set the covered bottle in it, which will take a little longer time. This special use will be most appreciated during the cold winter nights.

Other styles and sizes of the apparatus are also manufactured for physicians' use in sterilizing instruments and for kitchen use where greater quantities of water are needed for different purposes.

A Comfortable Electric Foot-Warmer Pad

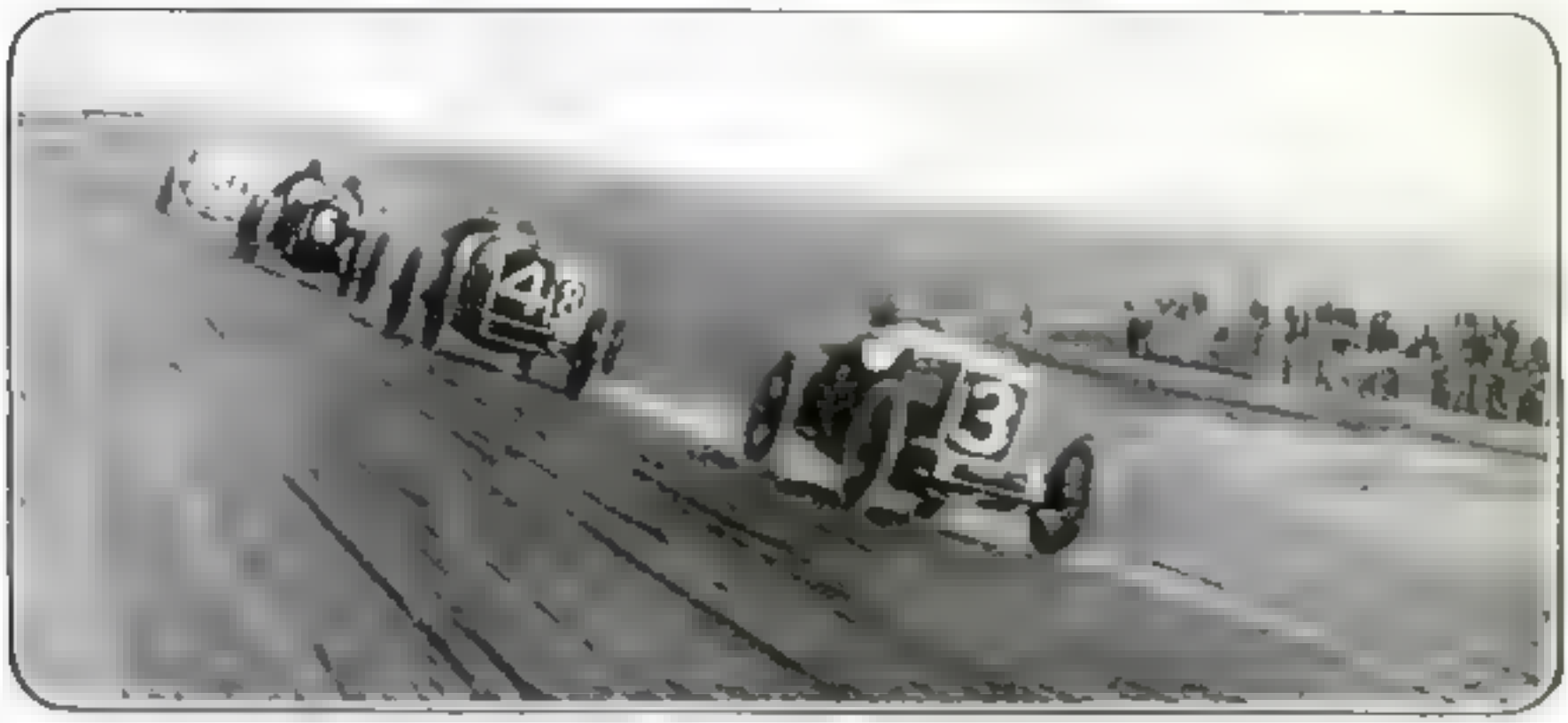
THOSE who are heir to all the ills resulting from cold feet will welcome an electric foot-warmer, recently put on the market. The heating coils form an oblong pad which is encased in a removable and washable eiderdown cover. A pair of soft slippers of easy fit are also provided. There is no reason why the pad may not be used to keep the feet warm while in bed also. It may be taken even into the automobile if arrangements can be made to connect it with the power. Wherever there is an electric lamp socket or the means of applying the current, the foot-warmer may be used.

Invalids, convalescents or anyone of low vitality will be sure to find it a comfort during the cold weather.

The heating coils form an oblong pad which is encased in a washable cover and connected with the lamp-socket

Timing an Automobile Race

The Mechanism of the Judges' Stand



Here they come, snorting fire and skidding around the curve at a hundred miles an hour. At such speed, is it any wonder that the judges' records sometimes become confused?

WHEN twenty or more racing automobiles lined up for the start in the big speedway races during this summer and fall, Numbers 13 and 20 were missing. Number 13 was out because no driver will risk his life in a car with that ill-omened designation. Number 20 was omitted because of a mistake which occurred in the important Astor Cup race last year and which temporarily reversed the order of finish and almost resulted in the loss of $1,500 to the misplaced racer. This error was made by misinterpreting the call 22 for cars 20 and 2.

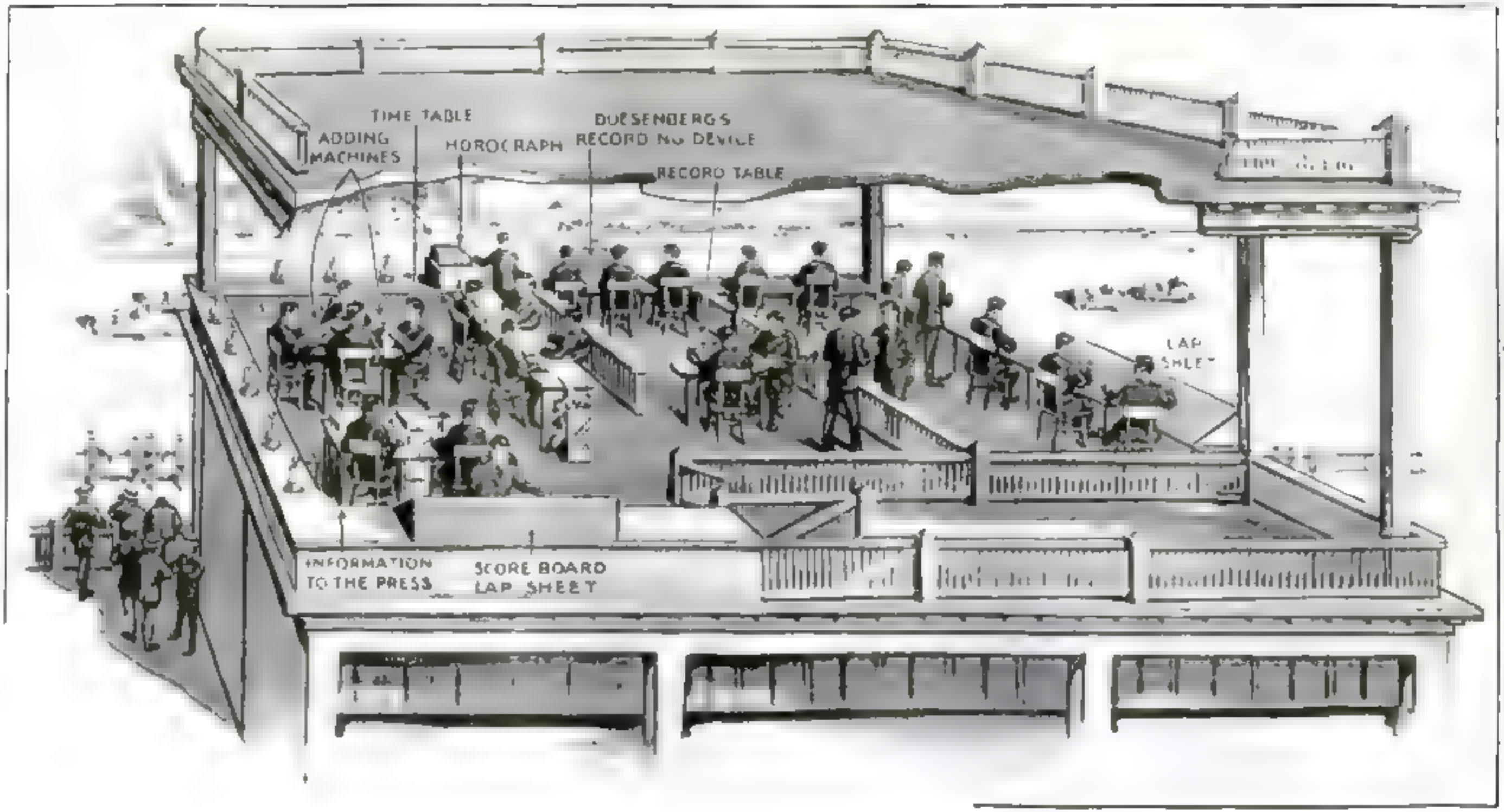
Eight checks and double checks are necessary before the judges can decide the final positions of all of the contestants in a race. Few realize that at a maintained speed of 102.6 miles per hour, which was attained last year, the cars shoot by the judges' stand at the rate of approximately 150 feet per second. With seven or eight automobiles flashing by the stand almost simultaneously at that rate and across the finish line, less than one inch wide, it is easy to overlook one and make a costly error.

To obviate mistakes, the work of timing the cars is divided into four parts: 1—Getting Knowledge. 2—Checking Knowledge. 3—Calculating Knowledge, and 4—Dissemination of Knowledge. The first division, Getting Knowledge, is the most important of the lot, because upon this knowledge, and the correctness of it, depends the accuracy of the checking, the calculation and the dissemination.

The entire group of timers is quartered on the upper floor of the judges' stand, generally inside the track, just opposite the finishing line.

The most important man in group No. 1 and the most important of the entire timing force is the caller. This man has nothing to do but to call off the number of each car as it passes him.

Directly in front of the caller are three men seated at the shelf or table as illustrated on the following page. Each of these men writes down the number of each car as called on blank sheets of paper torn from the pads and passed to a visor who compares them. If they tally, he then passes one along the desk to two men who mark the numbers down on the lap-sheet. This is a long piece of paper nailed to the desk and divided off into squares with the numbers of the cars at the left. Arranged along the top are squares, one for each lap of the race. As each slip bearing the numbers of the cars is passed to the two men in charge of the lap-sheet, they mark down opposite each car number its



The timers are quartered in three divisions in the upper part of the judges' stand. In the first division, at the right, are those who get knowledge, in the second division, in the middle, are those who check knowledge, and in the third division, at the left, are those who calculate and disseminate it. The caller stands in the first division and announces the cars to the men in front of him. The numbers are then entered on the lap-sheet, sixty seconds after each car completes a lap. In the second division are the checkers, registering the mileage of each car with odometers, and the record table, where reports are compared. In the third division are the horograph, which accurately times the cars, the adding machines, which calculate the speed in miles per hour, and the press or information table for newspaper men

position in one of the vertical columns allotted to the record for each lap.

This lap record shows the position of each car within 60 seconds after it has completed a lap, because not more than a dozen car numbers are written on any one sheet before it is torn off the pad and passed to the visor and in turn to the writers at the lap-sheet.

Group No. 2, Checking Knowledge, is made up of three men working two machines, one of which is a combination of odometers, one for each car. These odometers are used to register the mileage covered by each car, so that by dividing the reading as shown by the length of the track in miles, one can tell the number of laps credited to each car.

The other machine consists of two rolls of paper which automatically unwind at one end and wind up at the other by means of a crank attached to the odometer. That portion of the paper which is between the rolls is covered with celluloid except for a narrow slot which permits a thin slice of paper to show through. As the operators push down the odometer lever for any particular car, the man at the celluloid machine marks that number on the paper showing through the slot, and as the lever jumps back to its original position, the paper roll unwinds and brings a new strip of paper across the slot. The record thus obtained is used to check against the odometer readings and the lap-sheet.

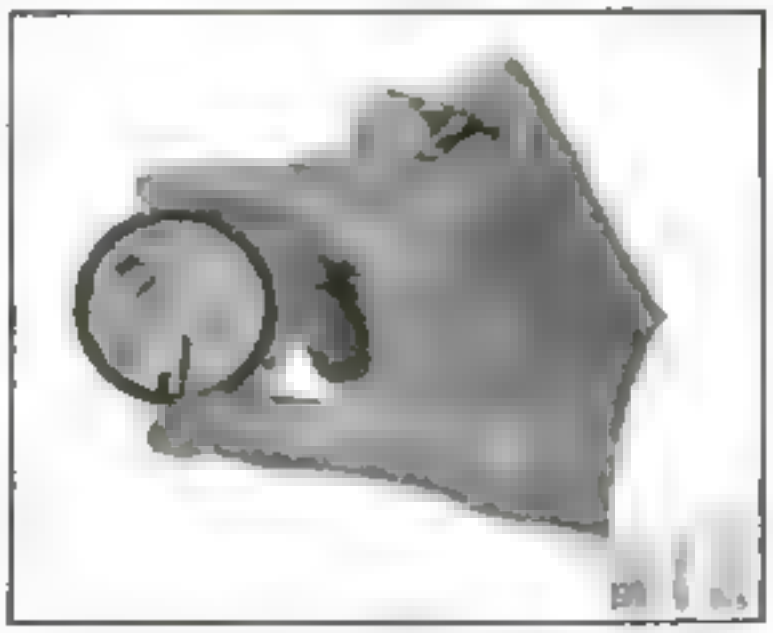
The mechanism of Group No. 3, Calculating Knowledge, consists of an instrument known as the Horograph. This is somewhat similar to the apparatus used on the railroads for notifying a switchman that a train is coming by the ringing of a bell as soon as it has passed over a distant section of track. Electric wires are strung from the Horograph to the finish line on the track and as each car passes over them, an electrical contact is made which actuates a clock device forming a part of the apparatus so that the time of contact is automatically printed on a long strip of paper tape, similar to that used on stock tickers. This tape feeds out of the machine along a narrow table, as shown in the illustration opposite, where it may be examined without being picked up.

Although the time when each car passes the finish line on each lap is printed on the tape, the particular number of each car is not designated, so that some means has to be taken to connect the time as shown with the car which makes it. This is done by men stationed along the table who watch the cars as they pass and then mark the proper number opposite each time record.

Two men stationed along this table take the time records from the tape as it passes them and mark them on special ruled sheets and then pass the sheets to the round table which is shown adjacent to the tape bench in the drawing opposite, where two men operating adding machines calculate the speed in miles per hour and reckon special lap speeds, for which prizes are awarded.

Directly behind the calculators' table is another which gives information to the press and announces the winners to those not in the stand. This is in Group No. 4, Dissemination of Knowledge. There is also another lap-sheet for giving information to the scoreboard and the grandstands. Many telephones are provided for sending or getting information from the pits.

Backing an Automobile into a Moving Garage



It requires deft manipulation to get the automobile fitted into the garage

THE illustration shows a puzzle recently placed on the market. In a glass-covered circular box two movable objects are enclosed. They represent an automobile and a garage, and the object is to get them dovetailed into each other. The floor of the box is of polished wood, which makes the task more difficult.

The Electric Thief-Catcher

It rings a bell, takes a photograph of a burglar, and shoots him as soon as it sees his flashlight

By B. F. Miessner

ALTHOUGH this apparatus accomplishes some startling results, the idea of selenium-actuated burglar alarms is not altogether new. M. Dafoh, a French engineer at Jansac, suggested the use of selenium for this purpose several years ago; others have worked along similar lines.

It may be mentioned here that no attempt has been made to obtain patents on this apparatus; its use is unrestricted, and any one with the inclination may copy this arrangement for his own use or pleasure.

But what is this Electric Thief-Catcher? How can any machine or electro-mechanical contrivance *catch* a thief?

In the first place it does not catch him, if by catch is meant to pursue and seize, and perhaps to march him to the patrol wagon or police station. If by catching is meant to trap, then we may safely say that it does exactly that, and it can be made to do it as effectively as you please. The writer very narrowly escaped being quite effectively caught, when on one occasion this apparatus sent a thirty-two caliber bullet through his coat-sleeve!

By "as effectively as you please" is meant that the "catching" can be varied all the way from merely sending in an alarm, to frightening the intruder away, or actually shooting him dead.

All that is required of the burglar is that he possess a light of some kind, if it be only a match or a pocket flashlight, and that its rays fall upon the acute and ever wakeful eye of this hidden apparatus.

This electrical eye is a selenium cell such as is shown in one of the accompanying illustrations. All that it can do is to record its impressions by sending an impulse to the electro-mechanical brain of the apparatus, when stimulated by a light. That impulse is a surge of electric current when the resistance of the cell drops, due to the effect of the light. The cause of this curious effect is not yet understood but is being investigated by several men, among whom is Professor F. C. Brown, of the Iowa State University.

The brain is a sensitive relay, preferably one such as is used in the Electric Dog, which was described in the March number of *Popular Science Monthly*. This brain has the power to stimulate any one or any number of a great variety of electro-mechanical muscles, and to produce a corresponding variety of actions. In the writer's apparatus one of these was an electric gong, the burglar alarm; another an ordinary revolver whose trigger was pulled by an electromagnet; a third was a camera whose shutter was opened by a cord attached to the same electromagnet; a fourth, a charge of flashlight powder, which was set off by the heating of a short piece of fine resistance wire; and on one occasion a fifth was a phonograph with a specially prepared record, which, without a doubt would frighten out of his wits the boldest thief who heard its weird and uncanny warning.

Here, then, we have an electro-mechanical creature, which, hidden from all view, and with no human agency, will fire a revolver, send in an alarm, set off a charge of flash powder, and take the photograph of any marauder who prowls about with a light.

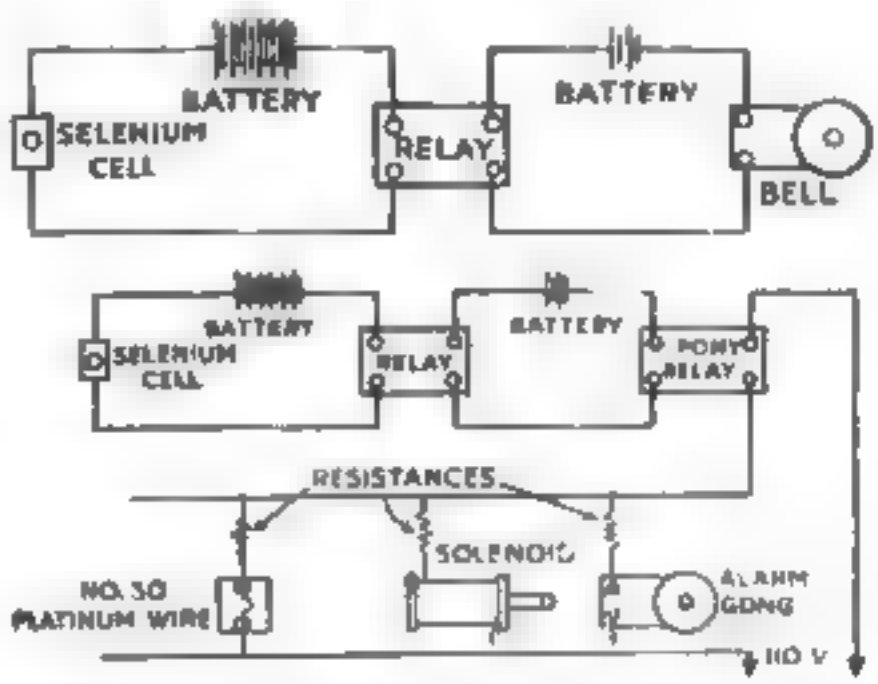
During the course of a lecture before the Chicago Electric Club and the National Electric Light Association, the author in the guise of the burglar stepped up to the platform in the darkened lecture hall, flashlight in hand; the instant the light fell upon the eye, the revolver began firing, the bell rang, the camera-shutter opened, the flashlight powder exploded, and the photograph on the following page resulted. In another lecture a phonograph was used and for five minutes there was enacted the

Shot by His Own Flashlight

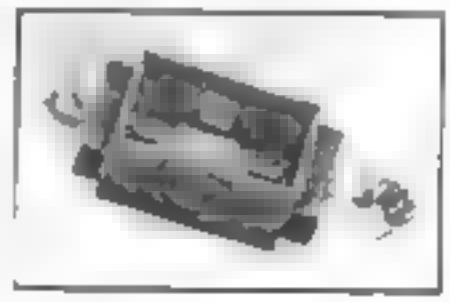
The burglar breaks open the desk and flashes his light upon the contents of a drawer. "Bang!" goes a revolver aimed at him from inside the desk. Simultaneously a bell is rung which awakens the household and sends in an alarm to the police station

invisible, but by no means silent drama which might follow such a catch in a home. The cursing of the burglar, the screams of hysterical women and crying children, the excited father, and a "drag-him-out-by-the-police-finale" were plainly heard.

The principal parts of the apparatus, which we have called the eye and the brain, are a selenium cell and a sensitive relay, the nervous energy is supplied by a battery of cells, which are connected in series with them as shown in the upper diagram. If only an alarm is desired, an electric bell and battery may be connected to the local circuit terminals of the sensitive relay. This bell will ring instantly when a light strikes the selenium cell, and will continue ringing as long as the cell is illuminated. It may be placed in a sleeping apartment at a distance from the room to be protected, so that the burglar will be unaware of the fact that his light has sent in an alarm. A device of this nature would be valuable for the protection of vaults.



Above: The dry cells connected in series. Below: The plan of the connections when several pieces are to be set off simultaneously



The selenium cell is the eye of the creature which when illuminated contacts the relay

The selenium cells may be purchased from scientific supply houses at a cost of about five dollars each. The relay should be as sensitive as possible; a good polarized relay may suffice but a galvanometer relay is preferable.

The battery should consist of a sufficient number of dry cells (these may be of the small flashlight type) to *nearly* cause the closing of the relay contacts when the selenium cell is in the dark, and when the back spring of the relay is in sufficient tension to prevent sticking of the contacts after the light rays are obstructed. When the cell is illuminated the relay should close promptly, and when the light is removed the back spring should pull the contacts apart without hesitation. In general the larger the number of batteries the more sensitive will the apparatus be, but with ordinary selenium cells the normal current should not exceed a few thousandths of an ampere. If the current is too large the temperature of the cell may rise to the point at which selenium begins to melt; this will destroy the usefulness of the cell.

From the relay, acting as the brain, we may lead connections to whatever apparatus we desire to be actuated when the selenium cell is stimulated by light.

When several pieces of apparatus are to be set off simultaneously, for example the apparatus before described, a connection arrangement, such as that shown in the diagram, should be used. One hundred and ten volts are suggested since this is the voltage of most lighting systems, and because a solenoid sufficiently large to pull the trigger of a revolver will operate best on that voltage without additional apparatus, such as storage batteries. Where several pieces of apparatus are thus controlled it is necessary to use an auxiliary relay, due to the delicacy of the sensitive relay, which cannot break currents in excess of a few fractions of an ampere. An ordinary pony relay of twenty ohms resistance is suitable for this purpose. If the arcing across its local circuit contacts is excessive a condenser connected in parallel with them will be found advantageous. The contacts should be set well apart and considerable tension put in the back spring to counteract the tendency to stick. Re-

sistances are shown in the separate circuits for the purpose of regulating the current.

If the mechanisms to be controlled do not require so much power a low voltage battery circuit may be used instead of the lighting circuit. The resistance of the flashlight wire should be low enough to permit of its heating to a red hot temperature when the current is switched on. To prevent this wire from acting as a short circuit on the other apparatus it should be small enough in size to actually fuse and break its circuit; ordinary fuse wire is not very suitable for this purpose, but fine strands of copper wire may be used in the absence of resistance wire. The charge of flash-light powder should explode within the one second during which the camera-shutter is open.

All of this apparatus may be installed in some hidden container such as a drawer of a desk, or of a chiffonier, or in a recess in a wall.

The selenium cell may be protected from the room lights by so arranging a contact on the lighting switch that, when the room lights are turned on, the power circuit of the apparatus is opened. This will prevent the setting off of the apparatus when the room lights are in use, but will in no way impair its effectiveness in the case of another light when the room lights are switched off. The apparatus may be protected from daylight by some simple form of time switch. A switch of this kind can be improvised easily from an old alarm clock, by fitting the clock with a circular conducting plate which will come into contact with the hour hand during a designated portion of the night. Should it be desired to leave the apparatus untouched for longer periods of time, clockwork mechanisms, which will run for the desired period of time, may be used. The revolution of a contact arm once in each twenty-four hours is necessary. A contact arm can be arranged which would cause the thief-catcher circuit to be opened say from five A. M. to seven P. M., or during the daylight hours. Another variation would be to utilize a second selenium cell well-exposed to daylight, which, when illuminated, would cut out the thief-catcher apparatus, by operating a relay connected to a break switch. Such an apparatus would be simple in mechanism and should offer no difficulties to the experimenter.

Field Photograph Kit for the Use of the Artillery

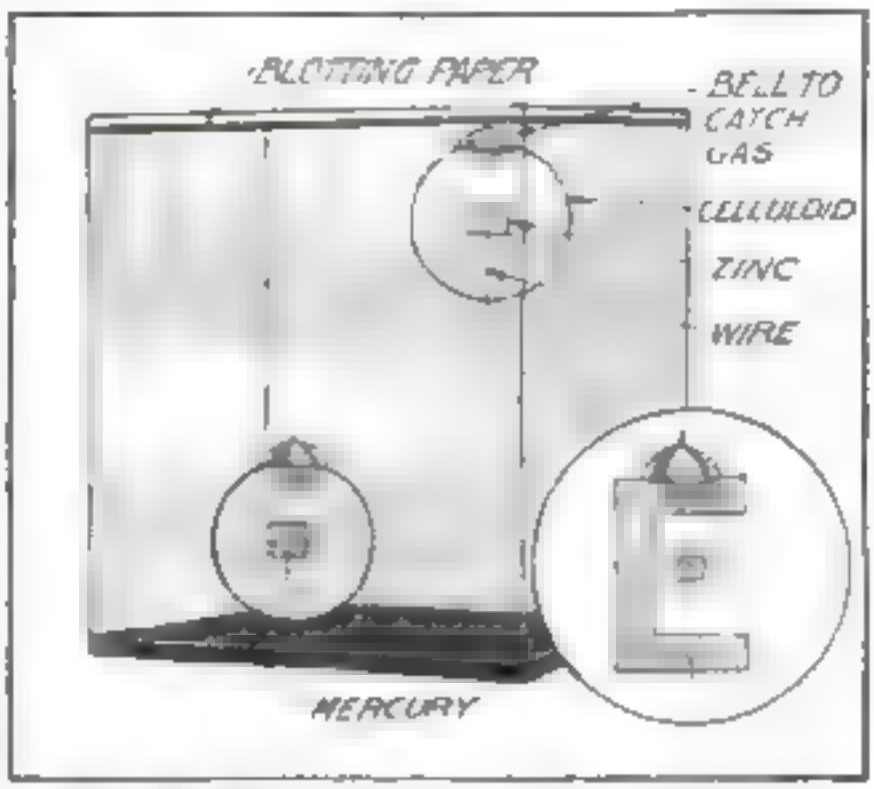
A FEW years ago the Signal Corps undertook the task of developing a photographic outfit that could be carried with a mobile army. After much experimenting a field telephoto equipment was designed which contained everything necessary for developing and printing negatives taken in the field by scouts.

A machine was obtained for projecting lantern-slides in a wall-tent, so that the commanding general could see on a large scale the surrounding country, etc. The telephoto-camera has proved somewhat useful in photographing the location of shots in field artillery work. When set up for developing and printing the kit resembles a suitcase on tripods. Two windows are provided. One admits red light for developing and the other white light for printing. The kit has not yet been adopted as a unit of army equipment.

A machine for developing and printing negatives taken in the field by scouts

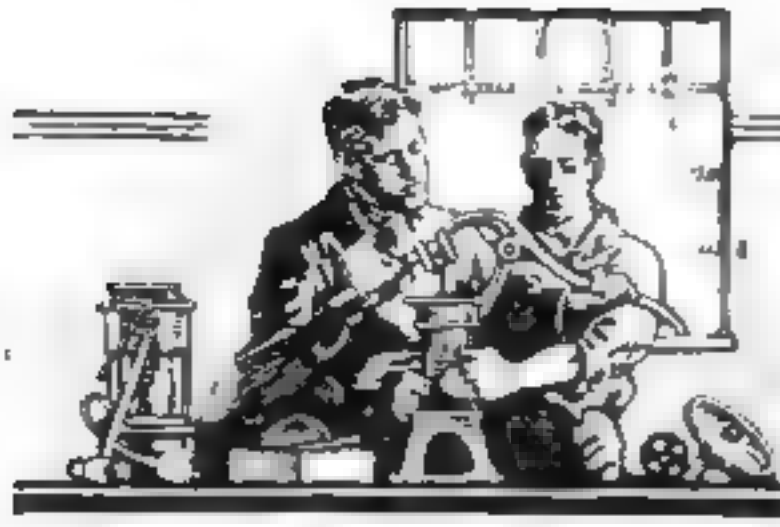
A Show-Window Advertising Device Operated by Gas Bubbles

THE device illustrated is based on the movement of a body caused by electrolytic action. In a glass tank of liquid is placed a celluloid or other disk which floats upright. On its top is a small bell-shaped body of any material. A metal plate is mounted at the middle of the disk and a wire leads down from it and projects below the disk. The end of the wire dips into mercury at the bottom of the tank, and thus makes electric contact so that an electrolytic action is set up.



The disk rises to the top of the tank where the gas escapes, causing the disk to sink

The metal plate is attacked by the acidulated water of the tank, gas coming off from the plate and rising so as to fill the small bell. The gas contained in the bell increases the buoyancy of the float and causes it to rise to the top of the tank, where the gas escapes out of a fine tube at the top of the bell. The gas could not escape at the bottom due to capillary action, but at the top of the tank the end of the tube comes against blotting paper and the gas escapes because the capillary effect at the end of the tube is destroyed. When the gas escapes the float descends again to the bottom of the tank, and the action is repeated. An advertisement can be put on the disk, or letters can be used.

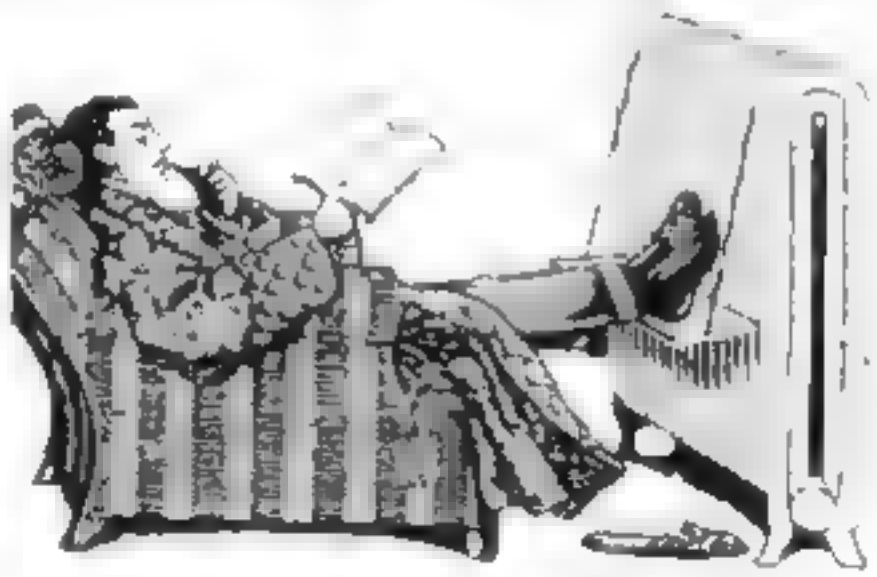


For Practical Workers

A Foot-Warmer Attachment for a Radiator

THE fact that air currents pass up through the sections of a steam or hot water radiator so that the heat rises before dispersing throughout the room accounts for the floor under the radiator being a poor place to warm the feet. The shelf arrangement shown in the illustration will be found very convenient for supporting the feet at a comfortable height near the side of the radiator close to the heat.

The device is made of a board 15 in. long and 6 in. wide, with two rods attached, having their upper ends bent into long hooks to engage the connections between the sections of the radiator at the top. This makes it easy to remove the attachment when not required. It may also be used as a shelf on which to set articles to keep them warm.—A. E. HOLADAY.



A shelf supported by long hooks attached to radiator connections for a foot-warmer

How Electricity and Temperature Affect a Watch

EVERY second counts—it counts half a revolution of the balance wheel of your watch, 1,800 revolutions an hour; so, anything that will affect that 12-in. coiled spring that governs the escapement may make you miss your train—or make your train miss its signals and safety.

The effects of varying temperatures have been compensated for even in watches that need not be very accurate, and especially in carefully designed timepieces. The effects of magnetism are also considered, the influence of which has been minimized in the last few years because of the development of electric generators. But watches still are liable to impairment from electrical influence, even in the slight amount of static electricity created by the friction of steel wheels on steel rails when a train or car starts or stops suddenly.

A simple experiment, showing how a watch may be magnetized without actual contact with the magnetizing source, may be conducted with paper, some steel filings and an ordinary magnet. The magnetic field will be indicated by the lines of force in which the steel filings will arrange themselves when the magnet is held under the paper. With a magnetizing source more powerful and its extent of influence proportionately greater, it may be readily seen how the steel in the watch may be magnetized—the steel parts, of course, retaining the magnetism, which, as the parts of the watch assume various relative positions in moving, causes them to be affected so that they are retarded or accelerated.

Whereas a watch in perfect working condition may be adjusted to vary only an average of .23 seconds daily, a magnetized watch will vary from 1 to 125 seconds an hour. Of course a watch may be demagnetized, but it

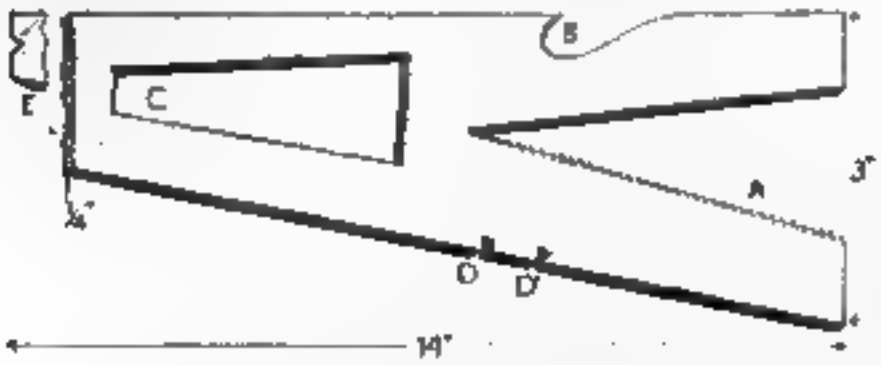
cannot be made immune. Watches are being constructed now with non-magnetic alloys in place of steel; but the alloys are not perfectly satisfactory.

The effects of temperature are taken care of more easily. The impairment of the hair-spring function is compensated for by the construction of the balance wheel, which has a rim of fused brass and steel. Each metal re-acting in differing degree to temperature, the variance in its contraction or expansion under the influence of cold or heat produces a bending of the rim, formed by two half-circle arcs. These are arranged and constructed so that the variation in the balance wheel will compensate for the variation in the hair-spring.

Many have wondered what is the purpose of the little screws on the edge of the balance-wheel rim. They are to give the wheel the exact weight, by their adjusted arrangement, to make the proper number of revolutions and to make even more accurate the balance wheel's compensation for variation in the action of the hair-spring under temperature effects. When heat weakens the spring, it reduces the diameter of the balance wheel to correspond exactly for compensation.

A Combination Tool With Many Uses

A VERY handy tool can be made from tool steel 14 in. long, 3 in. wide and ¼ in. thick. The teeth in the part *A* can be made with a three-cornered or half round file. A hole is drilled near the edge and the metal filed to shape as shown at *B* to make a bottle-opener. The hole *C* is used as a universal nut-

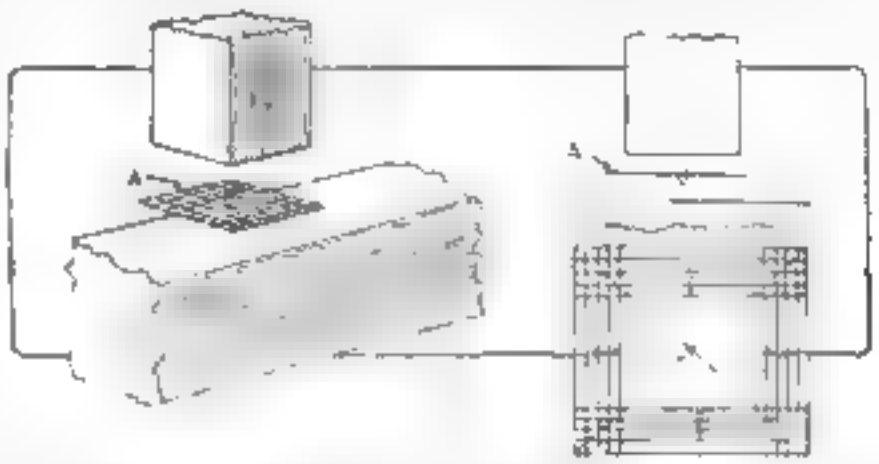


A combination bottle-opener, nut-wrench, saw-set, screw driver and tack-puller

wrench. Two slits are cut in the edge at *D* to make a saw-set. The end *E* is filed to make a tack-puller.

Marking Points to Bore Holes for Dowels

DOWEL joints must be exact. A good method for marking simultaneously in both pieces is shown in the drawing. A piece of tin or thin sheet metal is cut to convenient size and a bit of wire inserted in the exact center and



Marker to locate points for boring holes simultaneously in dowels to make neat joints

soldered, so that a part of it will project on each side of the sheet. To locate the center of the metal, draw cross lines diagonally from the corners. The point where the lines cross will be the exact center.

A more elaborate marker, large enough for all work, can be made from sheet brass or copper, with lines drawn parallel to each other, beginning at each side, ⅛ or ¼ inch apart. These lines should be numbered, starting with 1 from the outside edge and finishing near the center. When placed on the end of a square or rectangular piece the center can be located with these lines and numbers.

Place the marker on the end of the piece; then set it in the exact place on the other piece of wood and strike it. The pin points will mark both pieces.

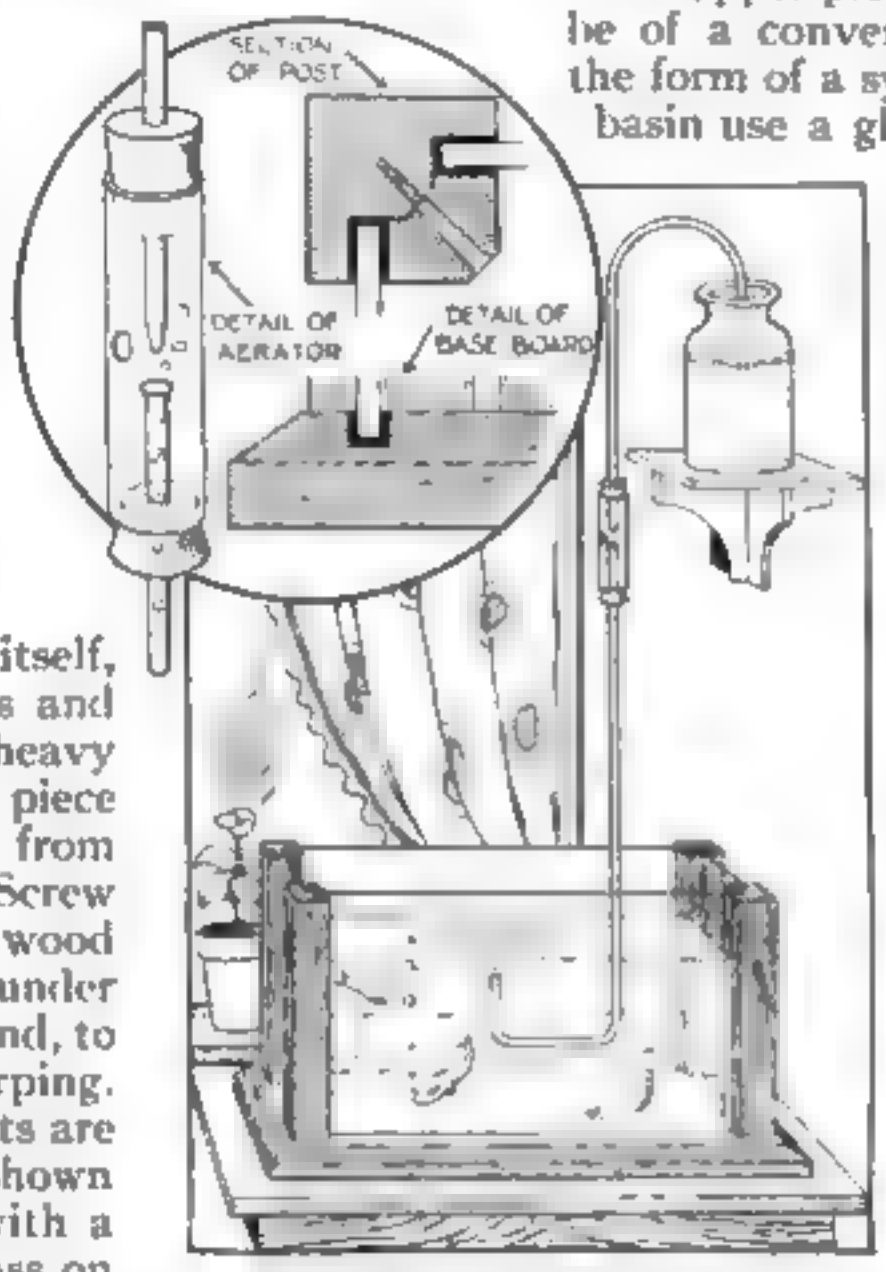
Painting a Ladderless Standpipe

PAINTING a ladderless standpipe proved to be too great a problem for several contractors, but it was solved by an old painter. He found out how long it would take to fill the pipe, and then had it emptied. He took several large timbers inside and built a raft, after which he ordered the doors closed and the pipe filled. By the time the inflowing water had borne his raft to the top, he had accomplished his purpose.—HAROLD HORINE.

To Keep the Water in the Aquarium Clean and Fresh

AN aquarium for the home may be equipped with a simple contrivance for keeping the water clear and fresh, thus overcoming the only difficulty in maintaining one. The aerator shown works simply and will go for months without other attention than to provide water for the supply basin.

In the drawing showing the apparatus there are the fish tank, supply basin, and glass tubing from the basin to the tank. The siphon forces a supply of air through the water in the fish tank. The tank consists of a baseboard which is slightly larger than the tank itself, four square posts and four pieces of heavy glass. The base piece should be cut from wood 1 in. thick. Screw two strips of wood across it on the under side, one at each end, to prevent it from warping.



An aquarium with an automatic supply basin and an aerator.

The corner posts are to be shaped as shown in the drawing with a rebate for the glass on the adjacent sides and a piece fitted in the inner angle to hold the glass in position. The base is also grooved on the sides and ends for the glass. Fit the posts by sinking them into a ¼-in. mortise cut in the base piece and then put a long screw into the end of the post through the base piece.

In fitting the glass bed in place use white lead putty made up with a little powdered rosin to cause it to harden quickly. The wood of the tank should be varnished and allowed to stand for one week before the tank is filled.

The aerating apparatus is made from ¼-in. glass tubing with a piece of ¾-in tube for the air-receiver and two corks. The ¾-in glass tube is 7 in. long and is fitted with a perforated cork at each end. A hole about ⅛ in. in diameter is filed in the side of the glass.

Fit the ¼-in. pieces of tube through the corks, one at each end. Take the lower piece, which should be about 3½ ft. long, heat one end of it and form into a slightly bell-mouthed shape.

The lower end is also heated and bent as shown in the illustration.

The upper piece of glass, which should be of a convenient length, is bent in the form of a syphon. For the supply basin use a glass jar.

After all the parts of the aerating apparatus have been fitted together, fill the fish tank and put the aerator in position; fill the supply basin also nearly to the top with clear water.

The upper part of the ¼-in. glass tubing is now taken out of the cork, and filled with water, holding a finger on each end. Then slip one end of the tube into the supply basin and the other through the cork of the air-receiver.

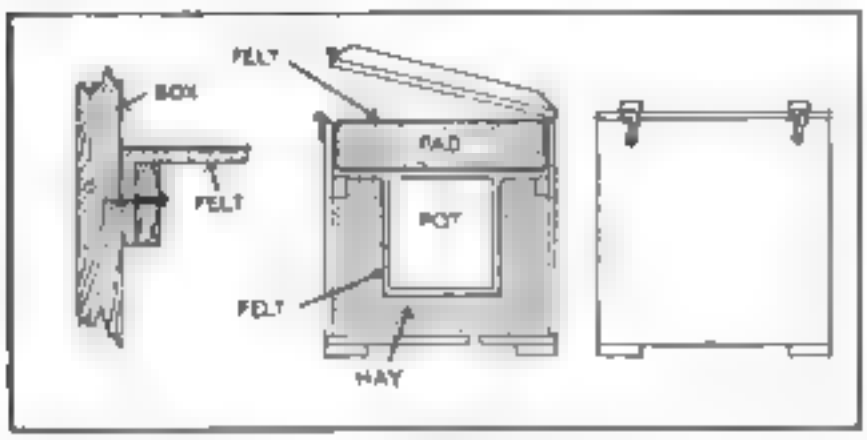
If this is correctly done, it will be found that the water begins at once to drop from the upper pipe, taking its supply from the basin on the wall bracket, and before very long it will be forcing a supply of air through the water in the tank at regular intervals. —JOHN Y. DUNLOP.

Making a Serviceable Fireless Cooker

THE cooker illustrated on the following page can be made with two or more pots, although the drawing shows only one. The outer part of a double boiler will serve for the pot. The first requirement is a stout box of suitable size, with the cover hinged. To prevent warping, it should be reinforced with

two braces. It is held down securely by two catches in line with the braces.

The upper part of the box is filled with a rectangular pad of felt stuffed tightly with hay. This is removable.



A felt-and-hay insulated fireless cooker to accommodate one or more pots as desired

The pot is completely wrapped about its sides and bottom with a felt overcoat. This may be made from an old felt hat which, if thoroughly steamed, may be easily shaped about the pot. If it is not wide enough to reach to the sides of the box, the erstwhile brim should be sewed to a square piece of stout material in which a circular hole has been cut. This rectangular piece is attached to the sides of the box by means of a ½-in. wood molding, as shown in the sketch. The final packing of the cooker is done as follows:

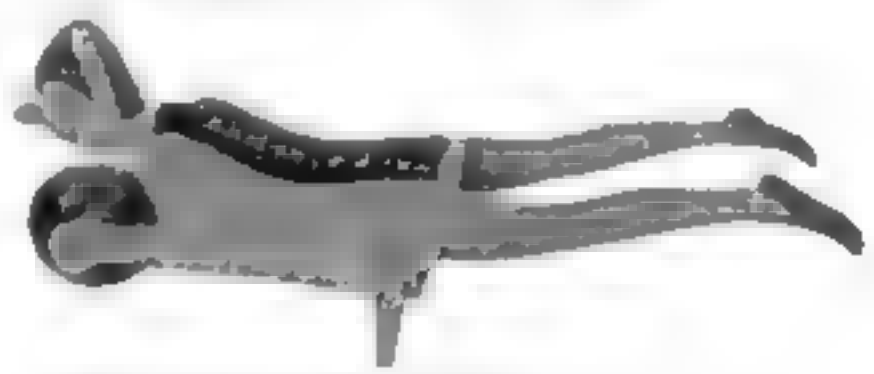
The bottom of the box is temporarily removed. The cover is lifted and over the pot the rectangular pad is placed. The lid is closed and the box turned upside down. Then the space that remains is filled with firmly packed hay, and when the bulk of this is in place all but one of the bottom boards are nailed down. Through the remaining opening more hay is crowded in until the packing is perfectly solid. Then the last of the bottom boards is secured. As a result of this arrangement the cooker is insulated at the top, sides and bottom by at least 2½ in. (preferably 3 in.) of packing. This prevents radiation and insures the efficient use of all the heat which will be stored in the pot.
—Robert G. Skerrett.

Loosening a Wood Screw to Draw It Easily

In an effort to remove a No. 18 wood screw which is 2 in. long, the slot in the head was put into such a condition that the screwdriver-bit would not engage it. The screw had rusted in the hole. A cold chisel and hammer were brought into use to cut another slot. After cutting the slot it was found that the screw came out very easily. The force of the hammer blows had loosened up the rust and also had spread the wood around the screw sufficiently to allow it to come out. The same operation was tried out on a screw which had the head entirely twisted off, and it was easily removed.

Transforming a Wheelbarrow into a Fantastic Toy

An example of how so prosaic a thing as a wheelbarrow may be made into a most alluring toy is shown in the illustration. As his clownship calls for grotesque rather than artistic lines, anyone handy with a saw and a sharp knife can fashion such a barrow according to his own ideas. The one pictured is in eleven sections—two legs, two sides, two end-pieces, the bottom, side standards, front wheel and head, which is carved on both sides



The parts of the wheelbarrow are cut out in the shape of a clown and decorated

First, roughly sketch the clown on heavy manila paper in order to familiarize yourself with the lines of his anatomy; then boldly draw six sections on bristol board, half of his figure sufficing for a pattern. Cut out these sections with a sharp, pointed knife indicating with a pencil what each one is. Any lumber will do for the barrow; even an ordinary pine box may be utilized if it is long enough to provide handles, the dimensions of which may vary according to the size required. The proportions of the figure shown are about as follows: leg, 30 in. to tip of toe; end-piece, 14 in.; side-piece, 27 in.; standard, 12 in.; wheel, 10 in. in diameter; head, 9 in. from the crown to nape

of neck. The shoes are carved on the limbs and painted red.

The queer handles have carved grooves that slip into the end of the side-pieces on the order of the old-fashioned wooden bedsteads. The wooden standards are "square pegs in square holes," and serve as rests for the barrow. They have an extension running up on the inside of the barrow, where they are bolted in place. The wood selected for the front wheel should be at least 1½ in. thick in order to afford stability The sides are sawed in such a shape that the iron rod from the wheel passes through the center of his clownship's palm where it is secured with screws.

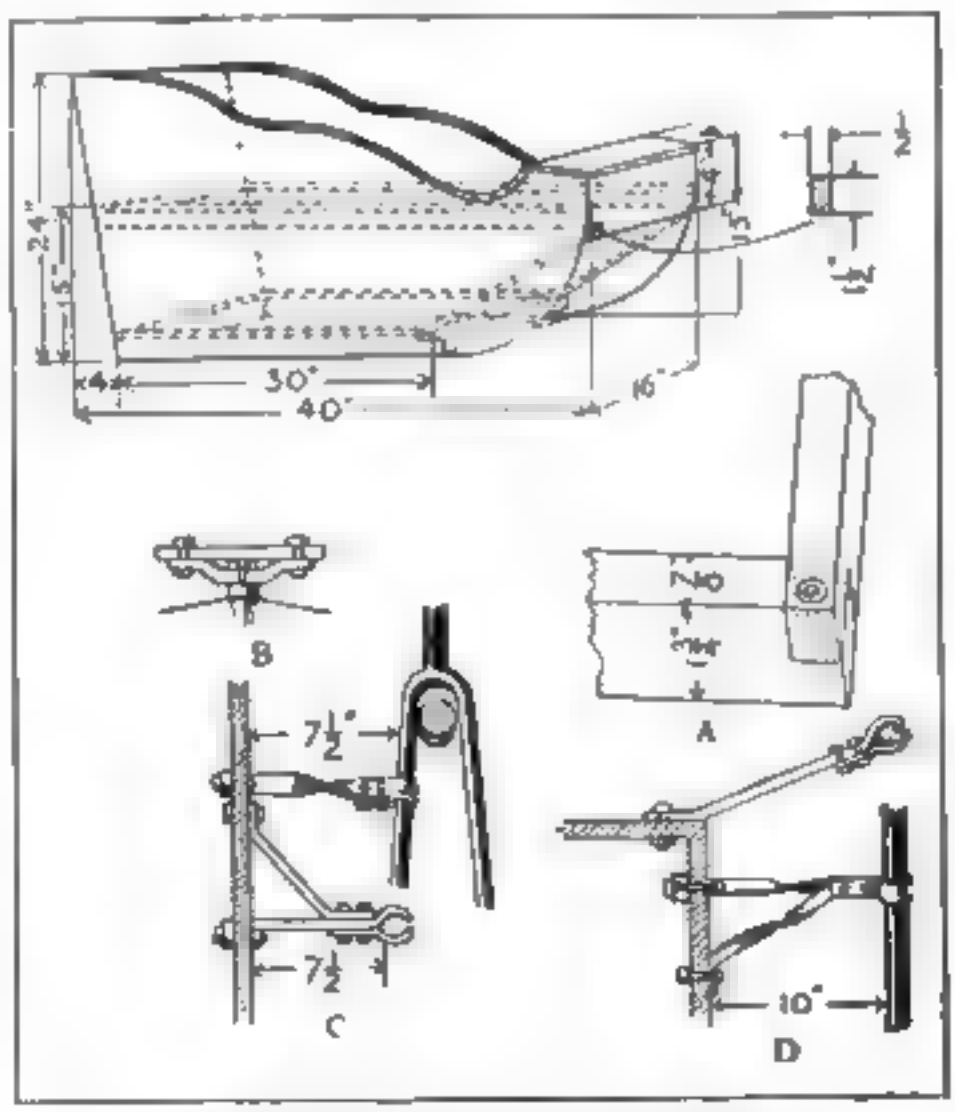
The sidecar as it is attached to a bicycle

Constructing a Sidecar for a Bicycle or Motorcycle

THE accompanying illustration shows the construction of a simple sidecar for a bicycle, which may be enlarged for motorcycle use. The frame of the sidecar should be strong, light and well made. Basswood will be found very durable for a light sidecar for a bicycle. The joints at the corners are lapped with a small bolt run through them to hold the parts tightly together as at *A*. The frame is rectangular, 30 in. long and 16 in. wide, made of pieces 1¾ in. wide and ⅞ in. thick.

The sides of the body are built up of ½-in. boards fastened vertically to the frame, and a side rail placed 15 in. above the frame, which is used for supporting the seat and also as a means of attachment for band-iron braces to the bicycle. Screws should be used throughout for fastening the boards to the frame and rails. First fasten them to the side rails, then draw the curved line at the top and cut both sides out at the same time after clamping them together. Before fastening them permanently to the frame, lay a floor of ¾-in. boards. A single board 16 in. long placed on the side rails makes the seat. The back is put on in the same way as the sides.

The side wheel, which is an ordinary front bicycle wheel, is attached to the body of the sidecar with braces of band-iron 1⅛ in. wide and 3/16 in. thick, the forward one being fastened over the side rail and the other to the upper rear part of the body. The inside end of the hub-axle is supported by a piece of the same band-iron shaped as shown at *B* and bolted over the side boards to the frame back of it.

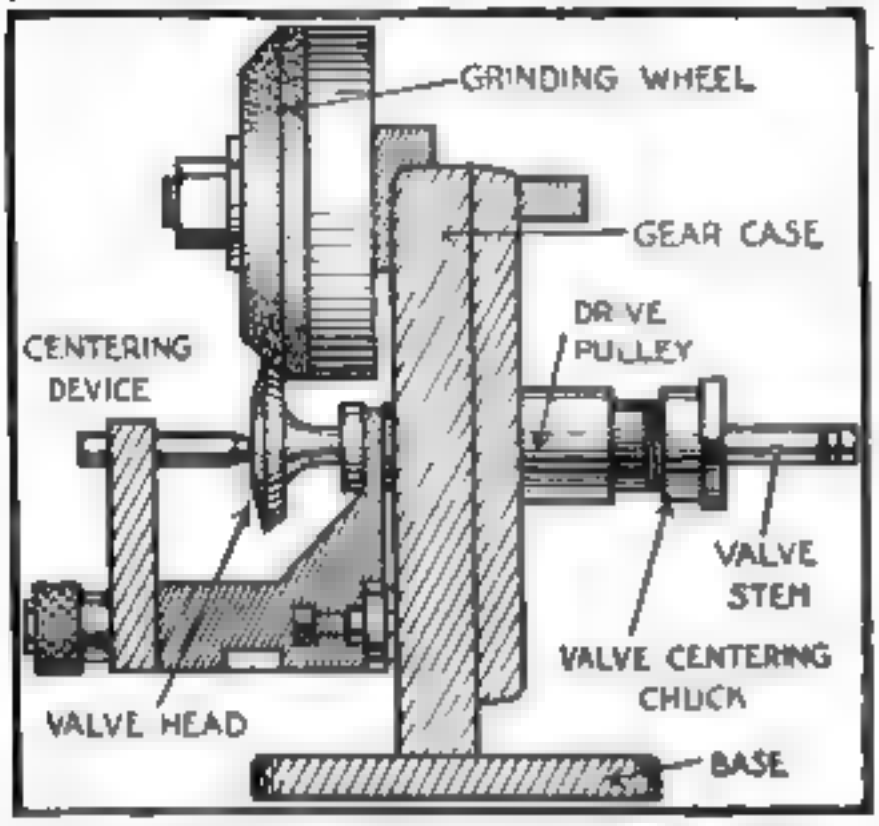


Details of the frame of a sidecar and its connections to a bicycle or motorcycle

The same sized band-iron is used for attaching the sidecar to the bicycle, one piece connecting the body to the bicycle frame between the large sprocket and the small one, and the other between the side rail of the body, through the boards to the tube connecting the seat and the rear-wheel hub. This is shown in *C* and *D*. The bars of the last attachment must be twisted slightly, as the drawing shows, to allow for the slant of the bicycle tube

An Improved Grinder for Gas-Engine Valves

AFTER a gas-engine has been used for a time, the valves, especially the exhaust members, are apt to become pitted and scored. In some cases, this roughening is so pronounced that it is almost impossible to grind the valves into a correct seating by the usual emery-and-oil process. The valve grinding will be considerably facilitated if the valve-heads are surfaced off



An abrasive wheel supported on a ball bearing shaft for valve-grinding purposes

An improved grinder for this purpose, recently marketed, is shown in the accompanying drawing. An abrasive wheel is supported on a ball-bearing shaft driven by encased gearing in such a way that its speed is fourteen times that of the valve-head and its direction of rotation opposite The valve is carried by an automatic, adjustable rotating chuck which insures that the valve will be properly centered, this being driven by a small pulley from any available power.

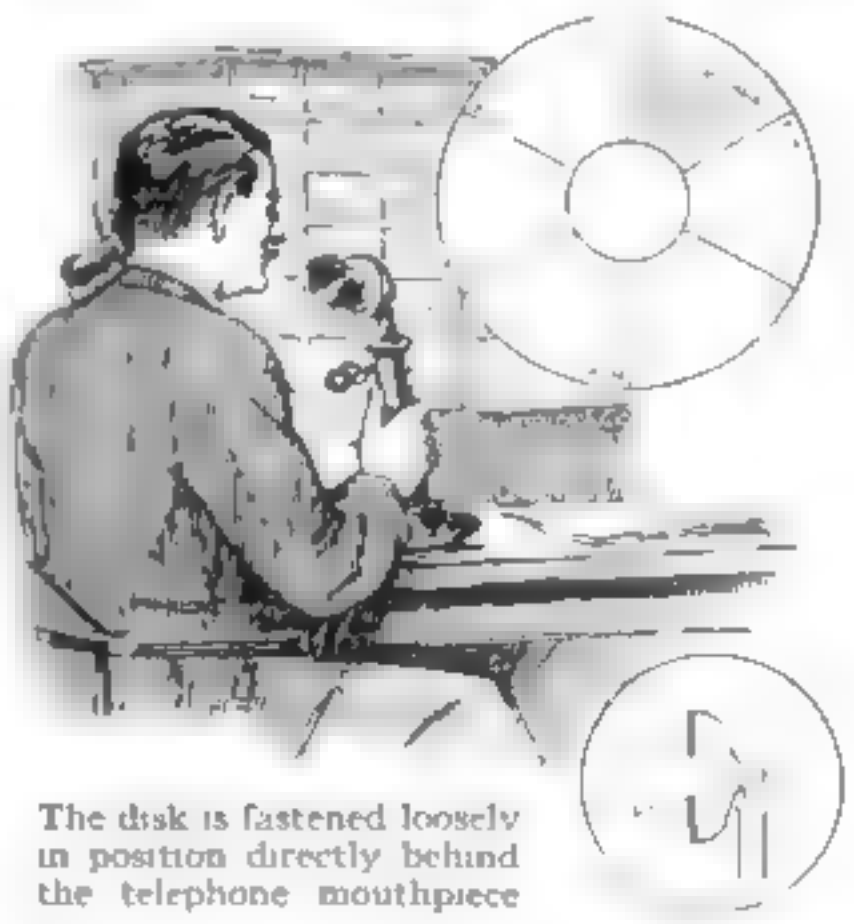
The abrasive wheel is properly beveled to make sure that the angularity of the valve-head will not be changed. A centering device is included to exert pressure on the valve-head and bring it in contact with the wheel. An integral wheel-dresser is also a part of the device. The tool shown has a capacity for valve-stems from 5/16 in. to 1/2 in. in diameter and valve-heads from 1 1/2 to 3 in., this range taking in most of the valve sizes in automobile engines.

A Fire-and Water Proof Cement for Mending Stove Fire-Brick

HERE is a formula for a cement which will repair fire-brick in stoves and furnaces, and which can be used even where there is an intense heat. Take 3 parts of fire clay and 1 part iron filings and mix with strong vinegar until a putty-like mass is formed. If the cement is used to fill up very small cracks and crevices, it should be thinner. If iron filings cannot be secured, fine iron borings will be just as good. If it is desired to use the cement in a furnace for melting metals, the following mixture will give better results: 1 part iron borings, 2 parts fire clay, and 1 part fire sand. Mix with vinegar in the manner described.

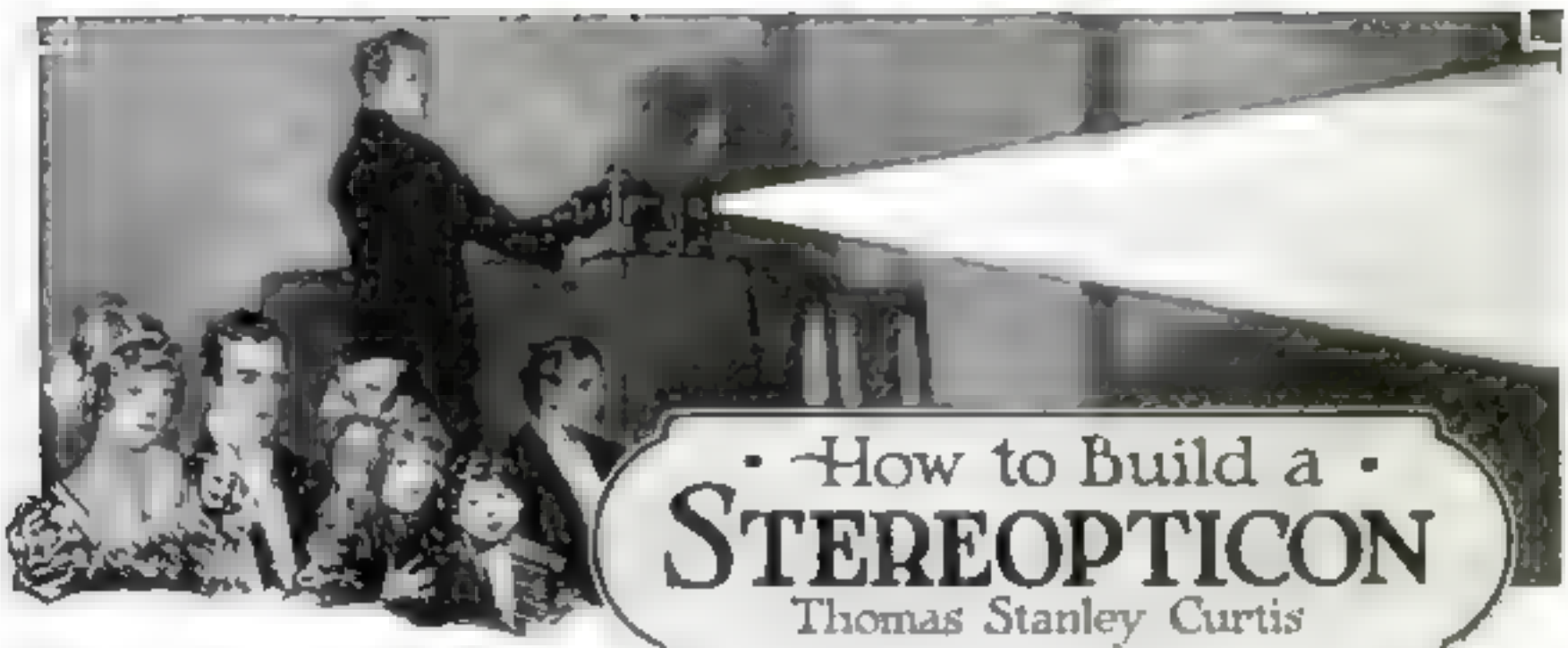
A Revolving Telephone Index on the Transmitter

EVERY user of a telephone has certain persons to call more or less frequently whose numbers may not be readily remembered. A list of these numbers may not be large and to look them up in the telephone book requires some time. A very handy



The disk is fastened loosely in position directly behind the telephone mouthpiece

and neat little index for a few numbers can be written on a cardboard disk and slipped on the neck of the telephone mouthpiece. It has six divisions and is fitted loosely so that it can be turned. The mouthpiece is unscrewed and taken off to place the disk in position.



How to Build a STEREOPTICON

Thomas Stanley Curtis

THE construction of a small stereopticon for use in the home or lecture room is an easy task for the workman who possesses the usual tools, such as a hacksaw, small drill-press, taps, dies, etc. The design presented herewith is one well adapted to amateur construction, and in the finished instrument the builder will have one which incorporates, in a simplified manner, everything which makes for comfort and efficiency in operation. At the same time, it will cost little to build if the objective and condenser are purchased second hand.

From the illustrations, the reader will note that the finished instrument is of the conventional form with one or two exceptions. The usual bellows is supplanted by telescoping cylinders of metal, the bellows is difficult to construct and, when made, it is no more effective than the device shown in the drawing. The conventional lamp-hood of sheet metal has been supplanted by an earthern hood made from a flower-pot; this construction permits the use of a simply-made arc-lamp without gears or worms and, furthermore, it prevents the heat of the arc from attacking the lamp parts. The heat is dissipated through an opening in the top, above the arc, and the condensing lens is protected by a disk of thin glass loosely clamped to the front of the flower-pot hood. Every detail of the instrument and dimensions is shown in the drawings; it is therefore unnecessary to repeat dimensions in the text of this article. Before starting the work, the builder should purchase the condensing lens, the objective and a slide carrier of the conventional sort. The condenser will cost, mounted as shown in Fig. 1, about $2. The objective, Fig. 2 *A*, will cost from $3 to $10, depending upon its quality, focal length, and condition, if second hand. The slide carrier of the sort shown in Fig. 3 costs about $5.

Fig. 1. The condenser

The focus of the objective will have an important bearing upon the length of the cylinders, *C* and *D*, Fig. 2, and the dimensions given are for a lens of 10-in. focus. This is an excellent size, as it throws a picture approximately 6 ft. square at a distance of 20 ft. from the screen. If the instrument is to be used in a smaller room, the objective should be of shorter focus. These objective lenses are usually supplied in a mounting, with a flange and a knurled adjusting knob, which actuates a rack and pinion arrangement. The following table shows the sizes of pictures projected by lenses of varying focuses at various distances. For example: With a lens having an equivalent focus of 7 in., a picture 6 5 ft. square would be projected if the machine were 15 ft. from the screen; 8 5 ft. square at 20 ft., etc.

The table is prepared as an aid to careful selection of a lens suitable to the room in which the stereopticon views are to be exhibited.

Size of Picture on Screen with Lenses of Different Focuses When Using Standard Slide

Focus of Lens	15 ft.	20 ft.	25 ft.	30 ft.
5 in.	9	12	15	18
7 in.	6 5	8.5	10 5	12.5
10 in.	....	5.8	7.3	8 8

The front board, which carries the objective, may be made first. The design is shown in Fig. 4, and the openings and general form should be described by measuring from the center line. The large openings may readily be cut with a fine jeweler's saw, or if the builder has a power-drill, they may be roughly drilled and finished up to line with a file. The lens-opening will obviously have to conform to the diameter of the lens-barrel or its flange, which is made of sheet brass, ⅛ in. thick and secured to the board with machine screws.

The lens-board is held upright by two rods of brass, Fig. 5, which slide into brass tubes. Upon these tubes the remainder of the instrument is assembled. The dimensions of the telescoping cylinders which supplant the bellows are shown in Fig. 6. These cylinders are made from thin sheet brass accurately cut and shaped by means of a tinner's roll. An accommodating tinner will usually be glad to perform such a small service without charge. The smaller cylinder should slide easily within the large one. It is then sweat-soldered to the lens-board, care being taken to see that it is exactly centered.

The slide-carrier holder, with the dimensions of its parts, is shown in Figs. 7, 8 and 9. The piece shown in Fig. 7 is soldered to the larger cylinder, *D*, Fig. 2 and the smaller ring of brass wire, Fig. 10, is sweated on at the junction. When the cylinder is to be soldered on, the rods and tubes should be in place and the one cylinder telescoped within the other, to insure accurate centering. As the assembled drawing shows, Fig. 2, the upright *E* is gripped between the collars *F* which are forced over the tubes and soldered in place. The dimensions of the collars are all given in Fig. 11. The parts of the slide-carrier holder are assembled by means of screws; and clamping-screws in the top piece are arranged to engage the slide-carrier and secure it in the proper position.

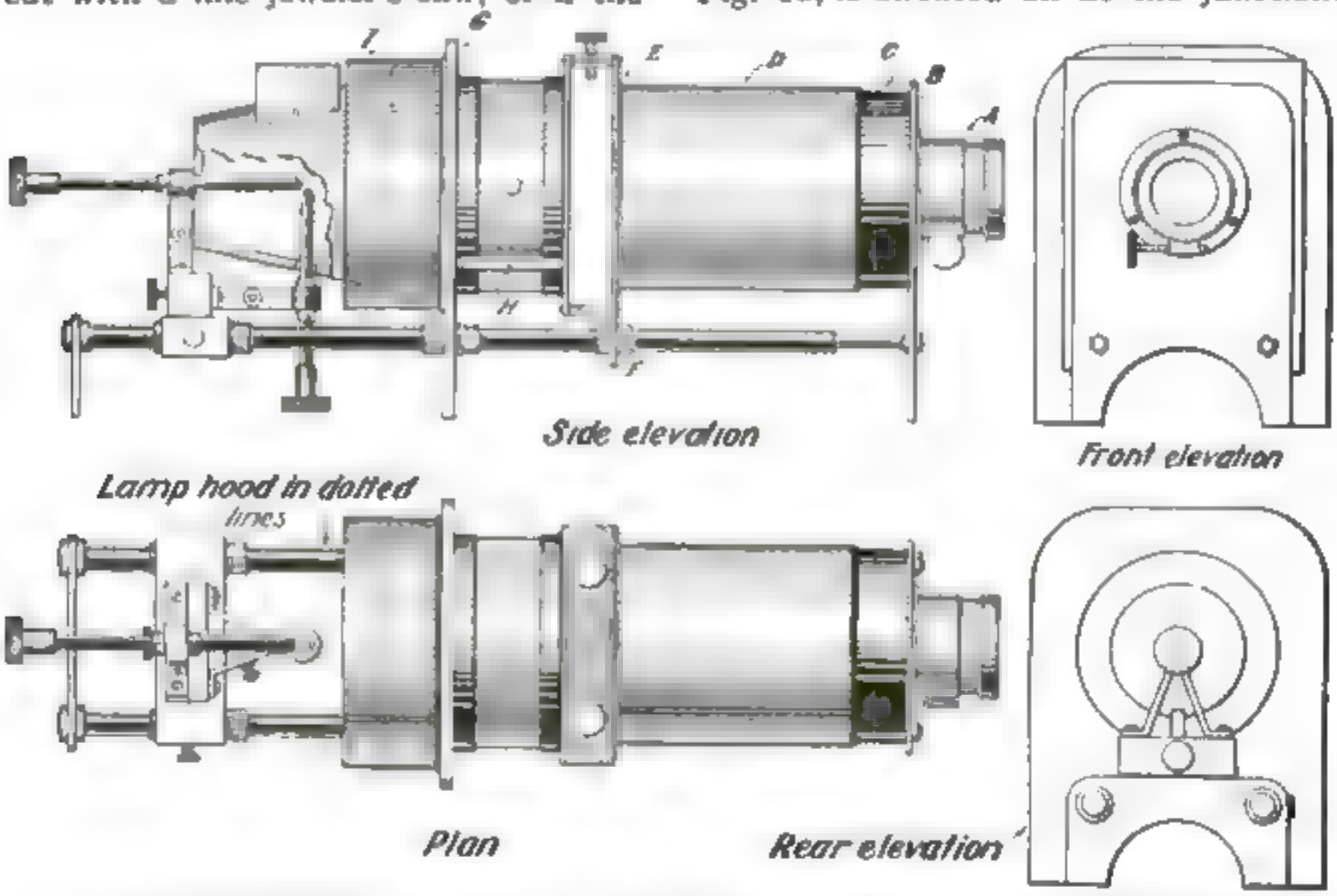


Fig. 2. The objective assembled. The lenses are usually supplied in a mounting, with a flange and knurled adjusting knob, which actuates a rack and pinion arrangement

The upright *G*, Fig. 2, serves to carry the light-shield *I*, which covers the lamp-hood. It also serves partially to support the condenser-mount, which is

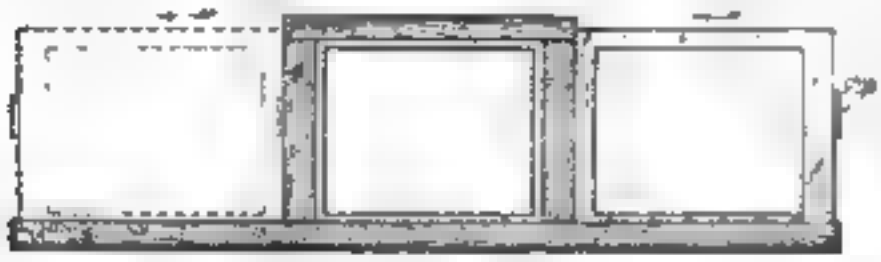


Fig. 3. A slide-carrier of the conventional sort, one of the parts to be purchased

loosely placed between the slide-carrier holder and the upright *G*, resting upon the studs *H*. The dimensions of the piece *G*, are given in Fig. 12. The light-shield *I*, detailed in Fig. 13, is to be hard-soldered to *G*. Owing to the heat encountered here, a far better construction is to bend feet all around the cylinder and rivet or screw it to the piece *G*. If soldering is determined upon, however, the larger ring shown in Fig. 10 may be used to strengthen the joint and to improve the appearance.

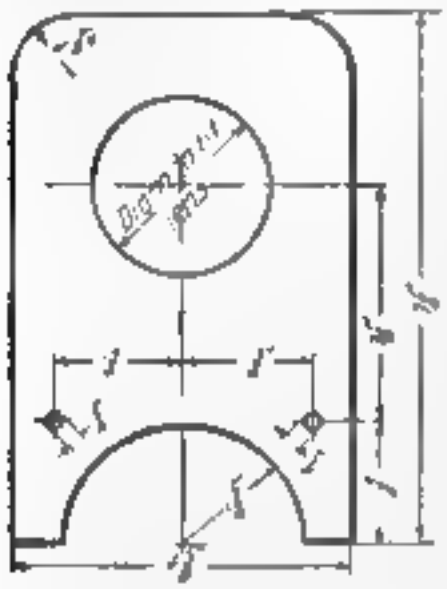


Fig. 4. Plan of front board which carries the objective

The arc-lamp illustrated in detail in Fig. 14 presents many points of interest. It is adapted for use on comparatively small currents of from 5 to 8 amperes, and these values are practically at the topmost limit for home use. The lamp takes standard ¼-in. carbons, which are fed by merely twisting and pushing the knobs fitted to their ends.

Each carbon of the lamp is held in a little bracket, which, in turn, is secured to a common base of hard fiber. The use of this material is permissible in the present instance, since the heat conducted to it is comparatively slight. The fiber-block is drilled to take the upright rod shown in the drawing and is fitted with a clamping-screw. This adjustment will permit the lamp to be swung to either side, or raised or lowered. Theoretically, if the objective, condenser and arc are in line, no adjustment will be necessary, but, owing to the extreme difficulty of securing such an absolute alinement, a degree of adjustment is usually necessary. The holders, through which the carbons pass, are split in order that a slight friction may be exerted upon the rods.

The hood for the arc, as previously stated, consists of a small flower pot of the correct size, drilled for the holes

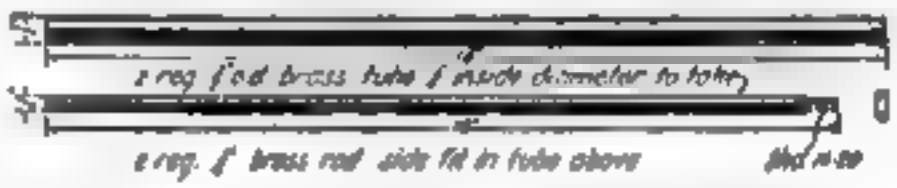


Fig. 5. Two brass rods which support the upright lens-board slide into brass tubes

indicated, and lined by smearing it with fire-clay on the inside. When the lining is dry and the hood fastened over the large opening in the top, the pot may be wired to the arc-lamp frame, or secured with small screws passing through the

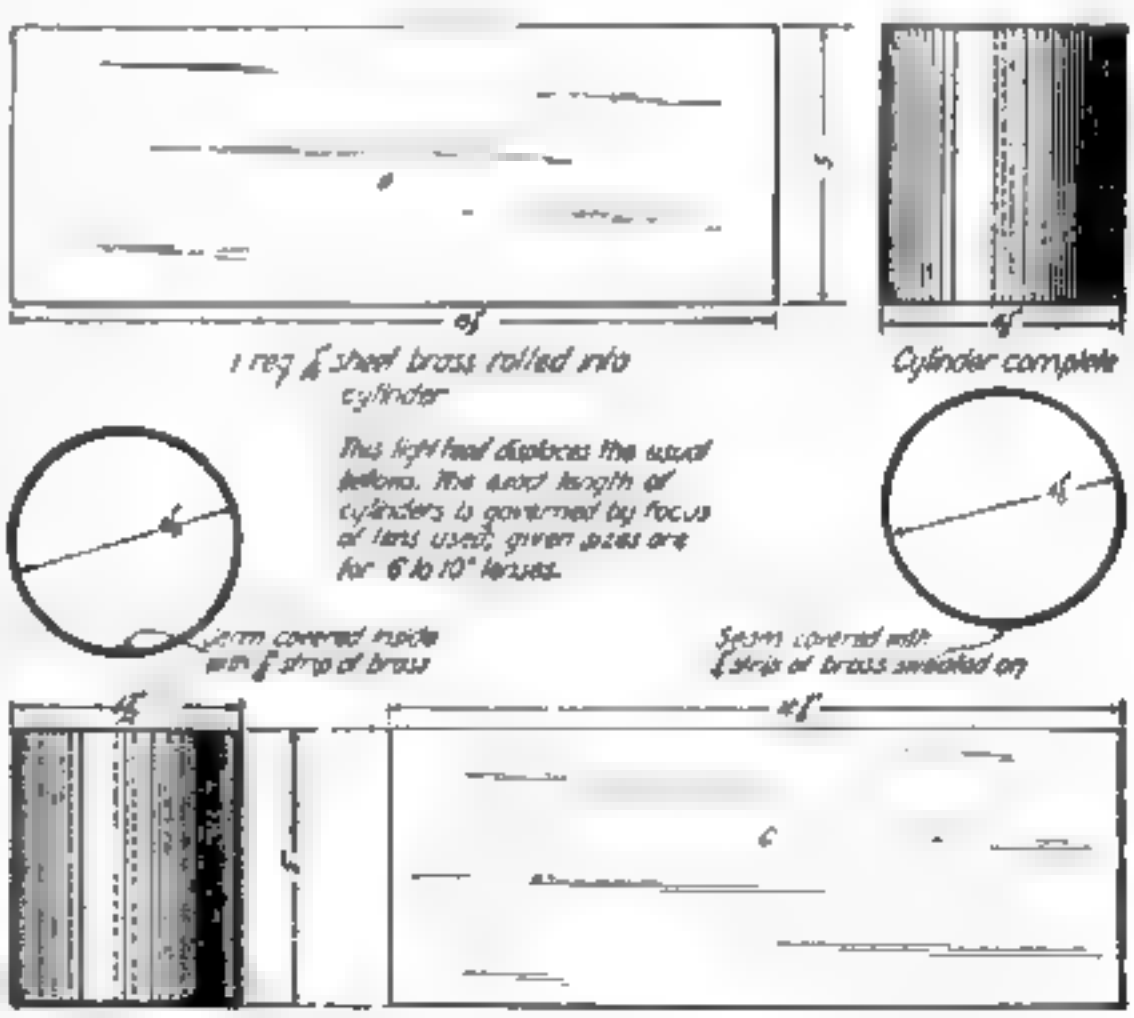


Fig. 6. The telescoping cylinders made of thin sheet brass accurately cut and shaped with a tinner's roll

bottom of the pot and into the brass bracket. The drawing shows how the disk of clear glass is clamped to the front of the flower pot. The method of constructing the lamp-mounting, which slides over the brass tubes of the instrument frame, is clearly indicated in Fig. 14. The addition of the rear support, detailed in Fig. 15, completes the stereopticon.

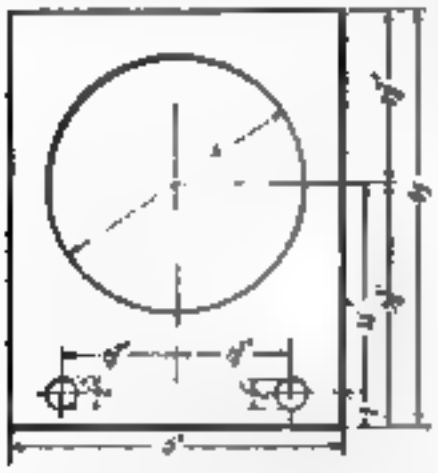


Fig. 7. A part of the slide-carrier holder

For the sake of completeness, the details of a small rheostat are given in Fig. 16. While a lamp-bank, or any other form of resistance that will limit the flow of current to about 5 amperes, may be used, the wire resistance illustrated will be found inexpensive and compact. The base is a piece of slate about 8 in. square in which are mounted nine brass pillars. On either side and between these pillars are stretched 9 coils of No. 22 gage resistance wire, each coil containing 5 ft. of the wire. If wound in coils of 48 turns each on a rod ⅜ in. in diameter, the amount will be approximately correct. As the drawing shows, the coils are all placed in series.

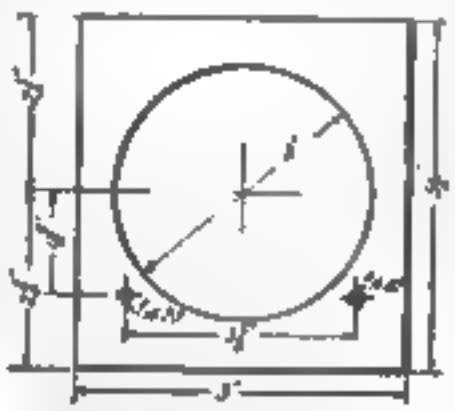


Fig. 8. Another part of slide-carrier holder

In Fig. 17 is given the diagram of connections. The wires leading from the nearest lamp-socket connect with a switch and fuse. One wire goes directly to the upper carbon of the lamp, and the other wire goes to one terminal of the rheostat. From the second terminal of the rheostat, a wire connects with the lower carbon of the lamp. If the current is direct, the upper or horizontal carbon should be the positive. This can be insured by a simple test; turn on the current at the switch and bring the carbons together for an instant, separating them immediately for ⅛ in. If the current is direct, the arc will quickly settle down to an absolutely noiseless burning; if alternating, the arc will emit a low hum. If direct current is used, turn the current off after the arc has burned a few moments and immediately observe the carbons; the positive will be the hotter one and if this should, by chance, be the lower, the wires at the lamp terminals should be transposed so as to establish the positive pole at the upper carbon. With a direct current arc, practically all of the light comes from the positive carbon, while with an alternating current, both carbons give off the same amount of light.

Fig. 9. Dimensions of the upper and lower frame parts of the slide-carrier holder

When the light has been tested, the stereopticon may be set up for use. Place the instrument upon a firm table and at right angles to the screen, which may be a sheet or a bare white wall. Start the light at the arc and darken the room. Place a slide in the carrier and bring the lens into focus by sliding the

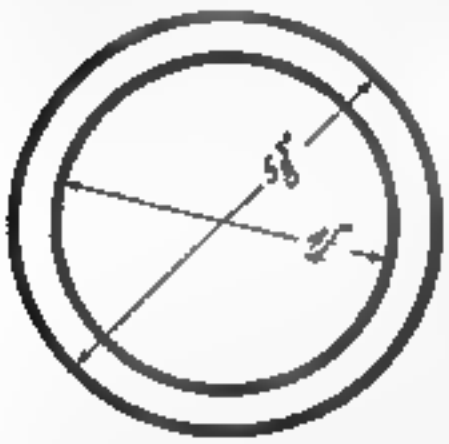


Fig. 10. Brass wire rings used to strengthen the numerous joints

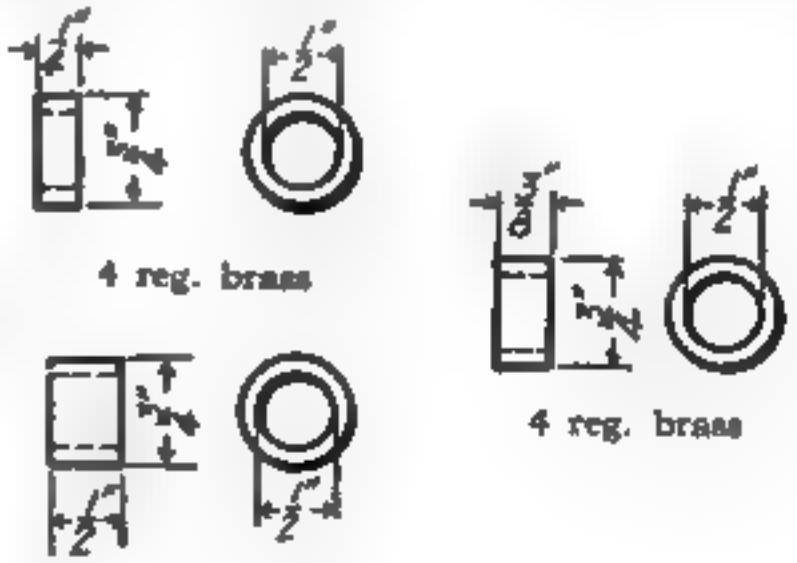


Fig. 11. Dimensions of the collars which are forced over the tubes and soldered in place gripping the lens-board

lens-board in or out. Remove the slide and adjust the arc-lamp to remove the bluish spots that will most likely be seen in the field of light. By moving the lamp up or down, to the right or left, or

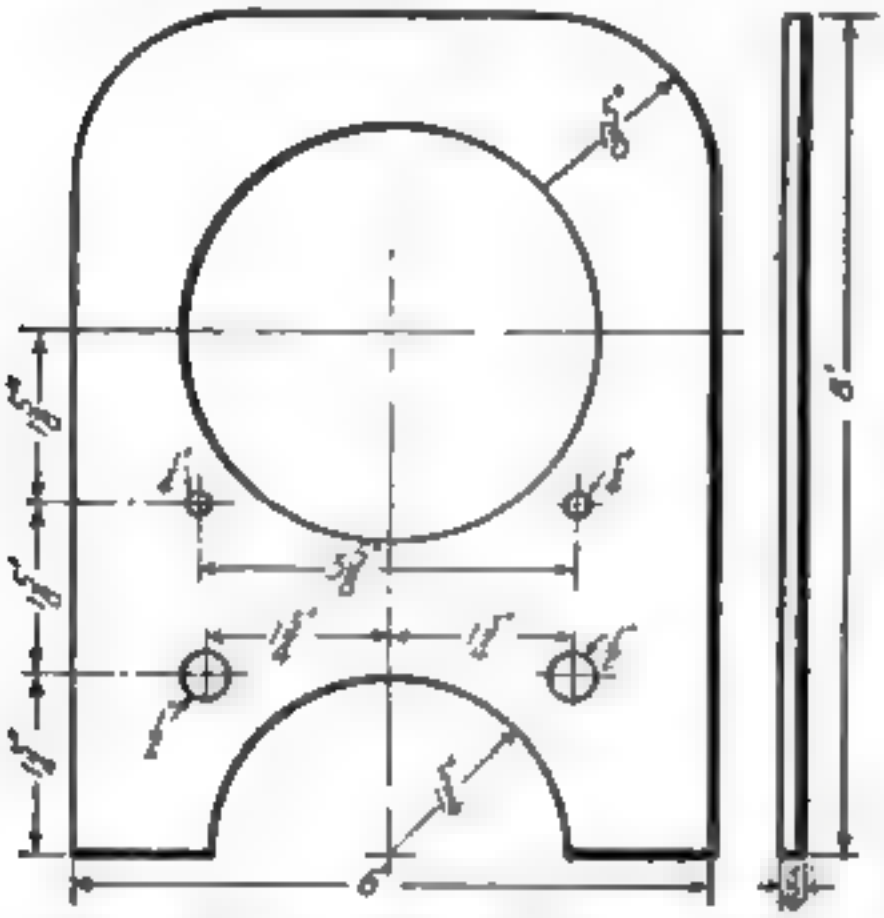


Fig. 12. Dimensions of the upright which serves to carry the light-shield

back and forth upon the tubes, the field will gradually be made perfectly clear. When the light is uniformly white, the slide may be replaced and a sharp focus obtained by turning the milled, adjusting knob on the lens-barrel. All lenses should be kept scrupulously clean, since the slightest trace of dust will diminish the brilliancy of the illumination to an astonishing degree.

Lantern-slide plates may be obtained from any dealer in photographic materials. The standard size is 3¼ in. by 4 in. in the United States, and all slide-carriers made for use in this country take that size. The lantern slide emulsion or coating is so sensitive that the slides must be handled under ruby or deep orange light only, in order to avoid fogging. With this one exception, they may be handled precisely as one would use the popular developing-out papers.

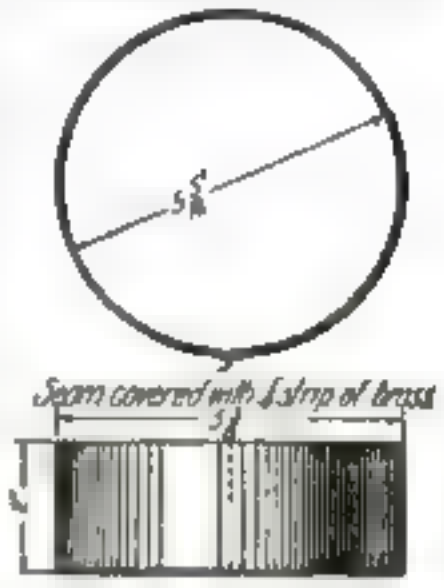


Fig. 13. The light shield which is soldered to the upright

To make the slide, the plate is placed in a printing-frame, with its emulsion (dull) surface next to that of the film or plate from which the print is to be made. The frame is then held at a distance of about 6 ft. from a 25-watt tungsten lamp, and the latter turned on for two seconds. This exposure is correct for the average negative and is cited merely

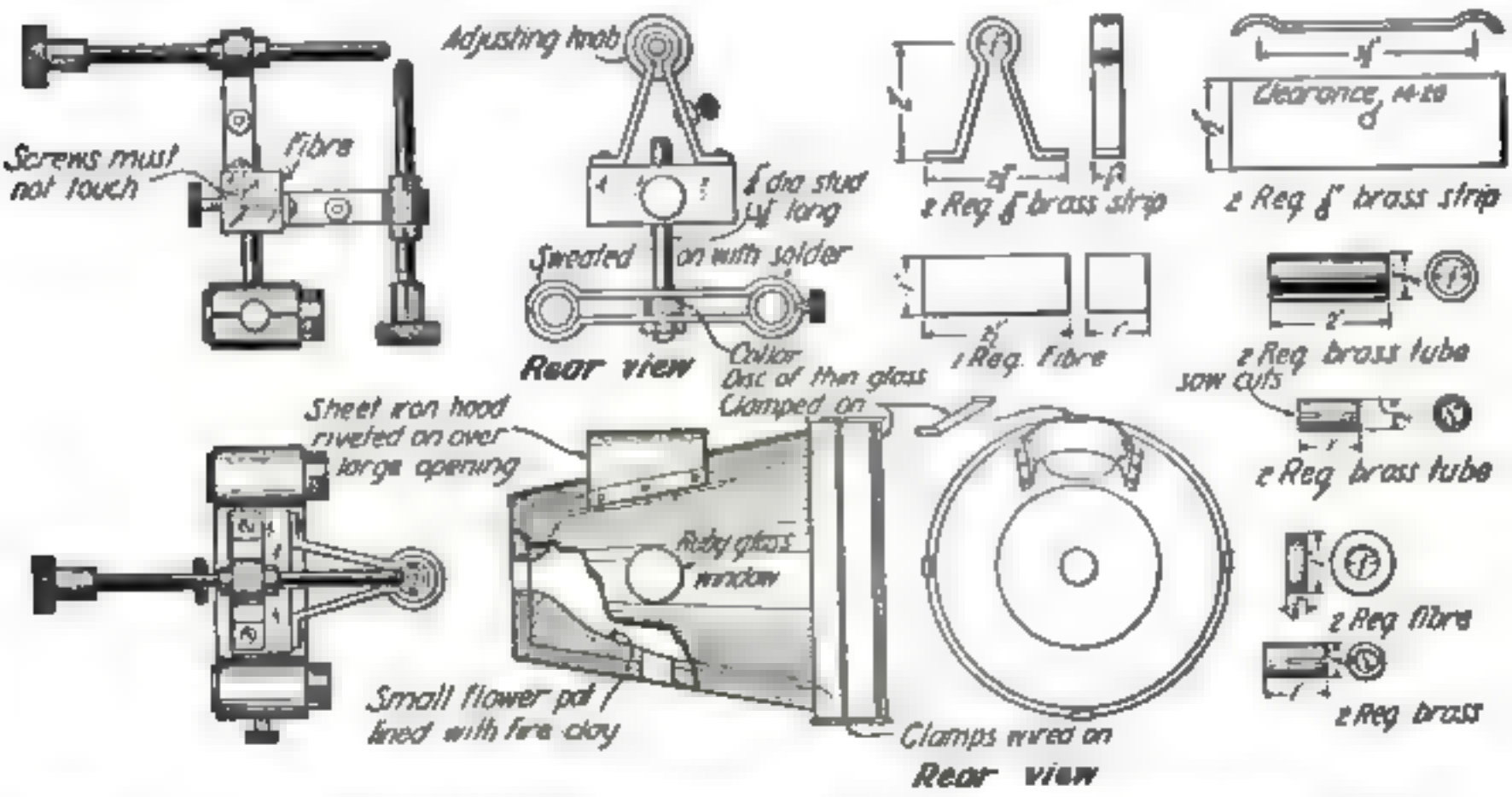


Fig. 14. Details of the arc lamp which is adapted for use on comparatively small currents. The carbons are fed by merely twisting and pushing the knobs fitted to their ends

as an example; even oil, gas or a match, held a foot from the frame, may be used instead. The exposure would then have to be determined by experiment, of course.

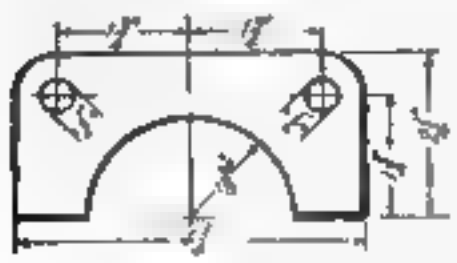
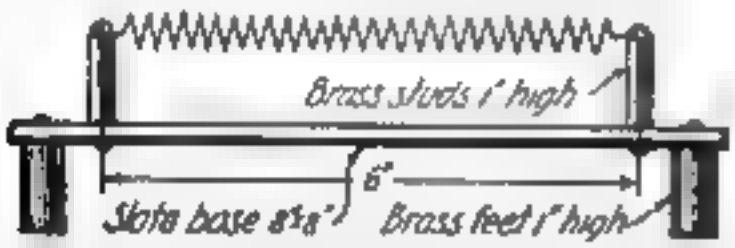


Fig. 15. Detail of the rear support

When the exposure has been made, the plate is taken from the frame and placed in a tray containing the developer. The writer favors the popular M Q., sold in tubes and merely dissolved in water. In about thirty seconds the details of the image will come up under the action of the developer, and in possibly a minute and a half, the development will be complete. This is determined when the entire image is plainly visible, though hazy, on the reverse side of the plate. Another test is to look for the details in the highlights; when they are visible, the plate is developed. The tray should be rocked continually throughout development.

The next step is to rinse the plate in clear water and immerse it quickly in a bath of hypo, which may be purchased in



3 Coils each containing 5 ft. of No. 22 resistance wire. Wind 48 turns on ⅜-in. rod

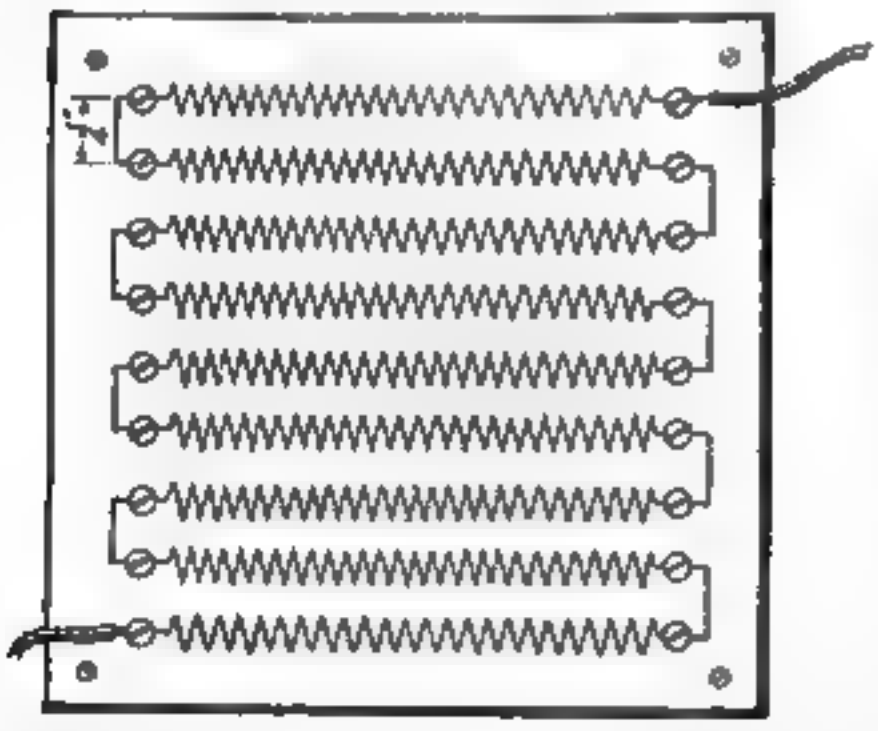


Fig. 16. Details of a small rheostat. In the slate base nine brass pillars are mounted

small packages ready to be dissolved in water. When no more of the milky whiteness can be detected on the plate when

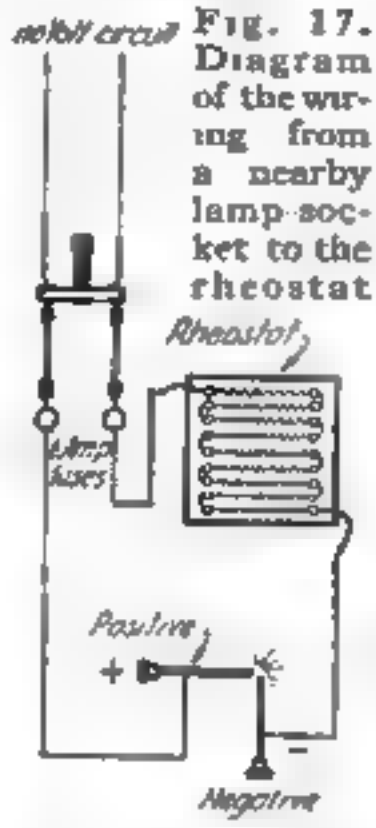


Fig. 17. Diagram of the wiring from a nearby lamp socket to the rheostat

viewed from the back, it should be left in the hypo ten minutes longer, and then taken out and washed under running water for a half hour. All of these operations must, of course, be performed under the orange light.

The trick which is perhaps the most important of all in the making of a slide has been left until the last, where it will be noted and remembered. When the slide plate is placed in the printing frame ready for the exposure, a piece of black paper should be placed over the back of it before the cover of the frame is clamped in place. This is to prevent a disagreeable foggy flatness from spreading all over the slide-plate, which will happen if the reflected light from the white backing of the printing frame strikes through the glass. The author has made hundreds of slides without the slightest difficulty since he discovered this little stunt. Prior to that time he had found it impossible to secure a brilliant slide from any but the snappiest of negatives.

A concluding word of caution is to avoid touching the emulsion side of the slide plate at any stage of the operations. The emulsion, when wet, is soft and easily injured and, when dry, the oil from the fingers will leave a mark. While the slide is drying, it should be protected from dust and dirt, preferably by placing it in a clean, dry place. A mat or mask and a cover-glass bound on the slide with passe partout binding complete the work

A Substitute Blow Torch for Soldering Joints

AN easily improvised blow torch for soldering joints in wires is made as follows: Take a ½-in. tube, and fill it with cotton waste or with old cloth saturated with gasoline. Cut a notch in a piece of ¼-in. loom, insert it into one end of the tube, and light the waste. Blowing through the loom makes a hot flame.

To Make a Storm Vestibule on a Veranda

AS may be seen from Fig. 1, the entrance to which the storm vestibule was added extends out into the veranda about 2 ft. beyond the general front wall line of the house. The

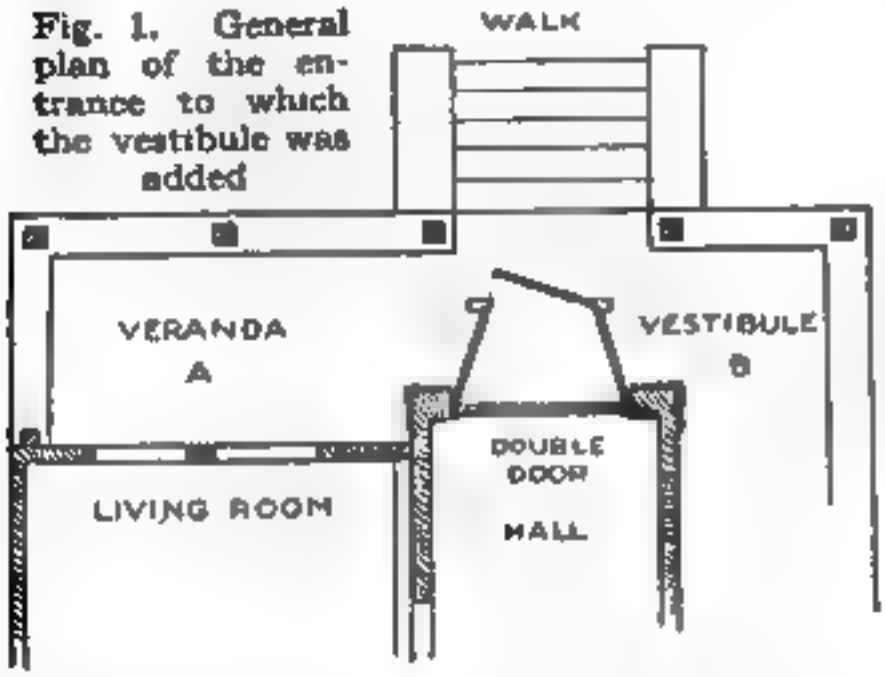


Fig. 1. General plan of the entrance to which the vestibule was added

veranda-roof is supported by five columns, about 6 ft. apart. Two of these flank the stairs from the walk to the porch. The hall is 6 ft. wide, and the big double door with glass panels, is fully as wide, less the trim. The makeup of the door-casing is such as to provide a good ⅞-in. stop all around outside. A sketch was made like Fig. 1. This shows that the narrow portion of the porch, which is only about 4 ft. from the door-casing to the posts, would be filled up by a rectangular structure, so that it would be inconvenient to reach either portion *A* or *B* of the veranda from the steps when the vestibule was in place. Therefore the shape was altered as shown, leaving sufficient room for a person to pass comfortably to either section of the veranda.

The plan of the vestibule is shown in Fig. 2. Its position on the porch floor is defined by the strips shown outside the side panels. These are square, about 1½ in. each way. They are screwed to the porch floor, and also to the side panels. The side panels and door frame are assembled as shown in detail of the joint at *C*. This joint is secured by screws passing through the door frame into the wedge-shaped piece, which is integral with the side panels. If the work is properly fitted, three screws on each side will be sufficient.

In the cross-section shown in Fig. 3, the construction of the top is indicated. This is made of tongue and groove fencing, the same as the side panels, and battened. The rear edge is made to slip in tight under the frame of the house door, and the battens are so placed that the side panels bear against them. It is not necessary to secure this piece except with two small hooks and eyes on each side, by which it is fastened to the side panels, so as to prevent entrance of cold air if it should warp. Sufficient projection of the top panel is provided to allow a crown-mold to be placed under it similar to that shown on the door frame in Fig. 3. This makes a cornice all around the vestibule, and is an attractive finish. These two pieces are attached to the side panels, and are mitered against the mold across the front.

The entire scheme consists of five pieces: two side panels, the top, the door frame, and the door. The door was purchased, with plate-glass upper panel, from a dealer in house-wrecking materials for a moderate sum. The rest of the material is plain lumber-yard stuff. The work of building and fitting such a vestibule must be carefully planned, and honestly executed. Skimped work will show and prove troublesome. But when once built it can be

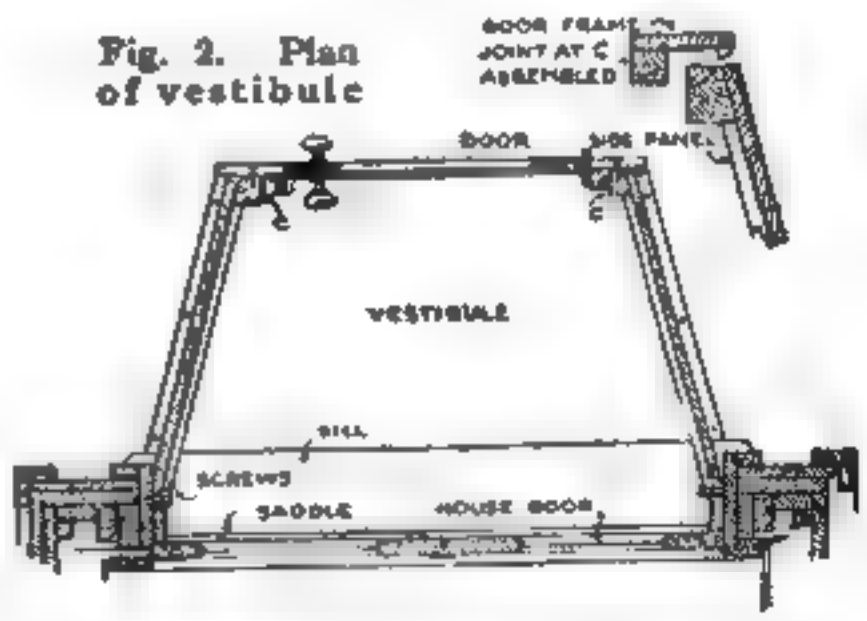


Fig. 2. Plan of vestibule

erected or removed in half an hour, with no tools but a screwdriver.

The door should be hung on loose pin-butts, of good weight and quality. They should be brass, steel bushed, with steel pins, brass tipped. The lock hardware and all the removable screws should be brass. This is because steel

screws would sooner or later rust in, and it would be difficult to remove them. All fitting and adjusting should be done when first building the structure, and it will then go together without trouble when erected afterward. The side lights shown are not necessary when the storm door has a glass panel.

The door for this particular model was made to open outward, as the vestibule was too shallow to permit of its opening inward. When sufficient depth is available, it is preferable to change the details so as to permit the door to swing inward. In this case, cheaper butts, plain steel for instance, may be used, as there is no weather exposure, and the lock may be a common rim or mortise affair for the same reason. All screws, however, should be brass in any case. The door may be weather-stripped when it opens out, but if opening inward it will usually be necessary to use a threshold, as the average porch pitches away from the house, and this must be provided for.

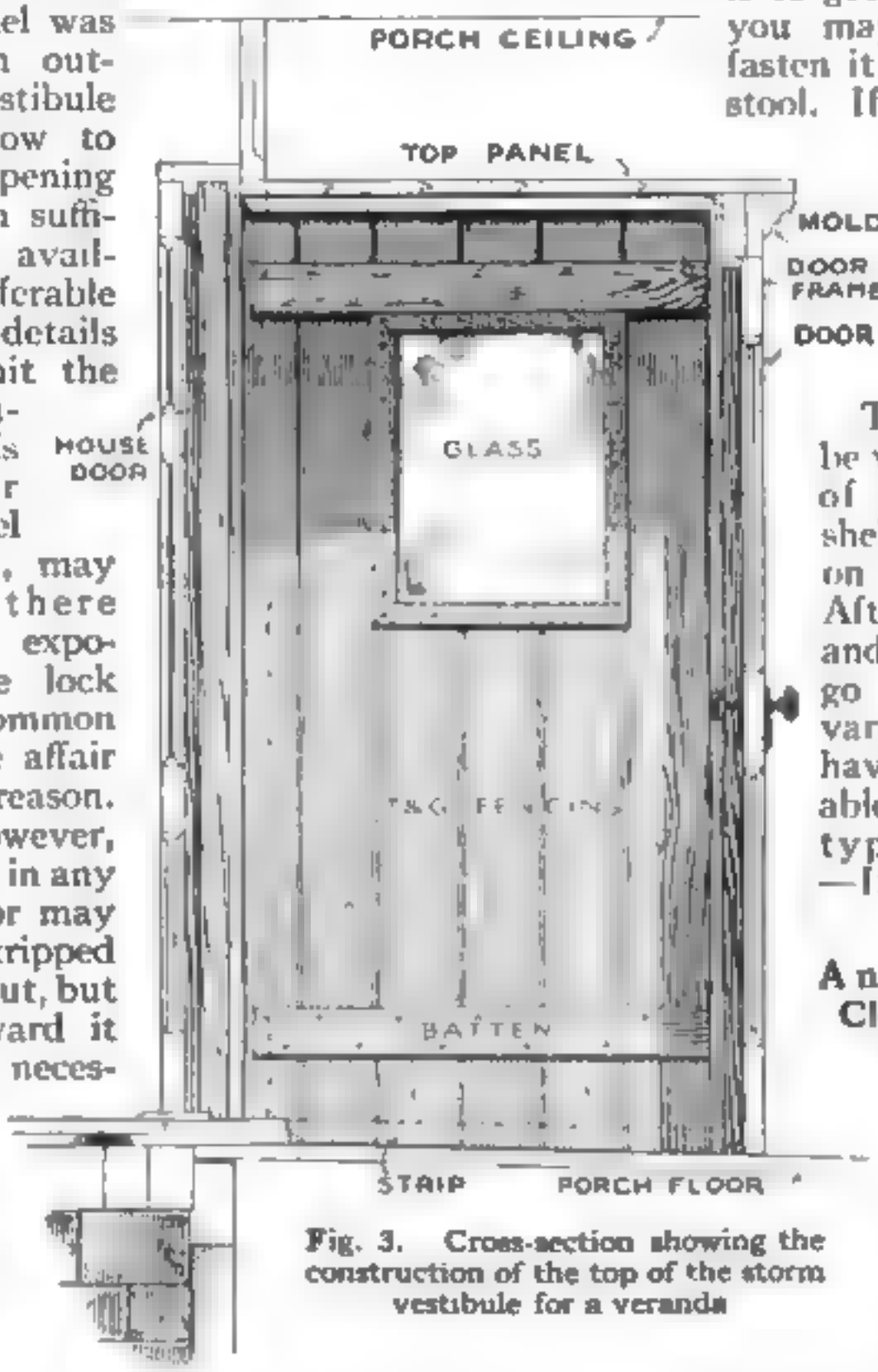


Fig. 3. Cross-section showing the construction of the top of the storm vestibule for a veranda

An Easy Method for Drilling Holes in Glass

IN drilling a hole in glass, first take any hard metal, press and turn it on the face of the glass at the point where the hole is desired until the glazed surface is broken. This will give a center or starting point for the drill. Then with a hand-brace and drill bore slowly, placing a little turpentine on the drill.

Utilizing a Piano Stool as a Typewriter Stand

A PERSON who uses a typewriter at home will find that a piano stool will make a very good stand for his machine. An ordinary table is too high.

A good way to make the stool even more serviceable as a typewriter stand is to get a board, the size you may deem fit, and fasten it to the top of the stool. If the stool will not turn up as high as you would like to have it you can build it up under the board you are using as a top.

The board used can be wider than the top of the stool, and shelves can be made on the extension. After the top is on and the shelves made, go over them with varnish and you will have a very serviceable and inexpensive typewriter stand.

—IRA R. ALEXANDER

An Emergency Clothes Hanger for the Traveler

WHEN traveling or visiting, one frequently is so situated that a clothes hanger is not available. A good substitute may be made in a quick and simple way, and the materials are always at hand. Roll up a newspaper loosely and tie in the middle with a piece of string, leaving a loop by which to hang it. This may be suspended from a gas bracket or other handy hook, and will take care of light-weight articles.

In washing an automobile use only soft water as it is not so hard on the finish, nor does it corrode uncovered metal.

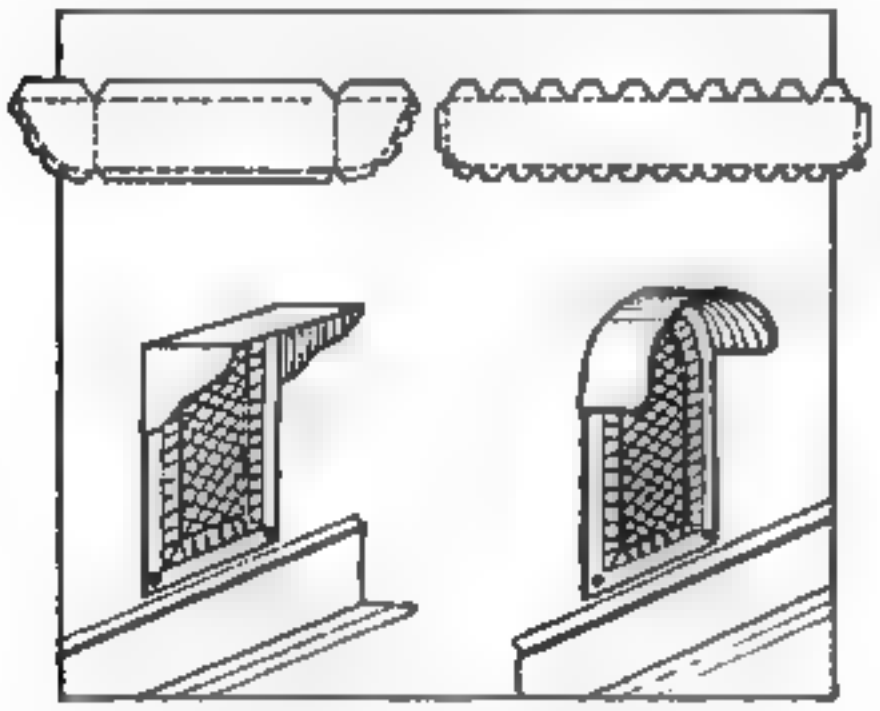
A Scheme for Soldering Metals Difficult to Join

MANY times when soldering together different metals which do not join easily it is better to put acid on each piece and fasten the solder to it separately. The pieces can then be soldered together without using more acid.

This method is especially advantageous for fastening two pieces together, where if acid were used, it might run into places difficult to reach with a cleaning cloth so that it could not be wiped away and would corrode the metal.

A Heat Deflector for a Hot Air Register

A SHEET metal canopy placed over the ordinary hot air register will direct the heat toward the bottom of the



The metal canopy deflects the hot air outward and down toward the floor

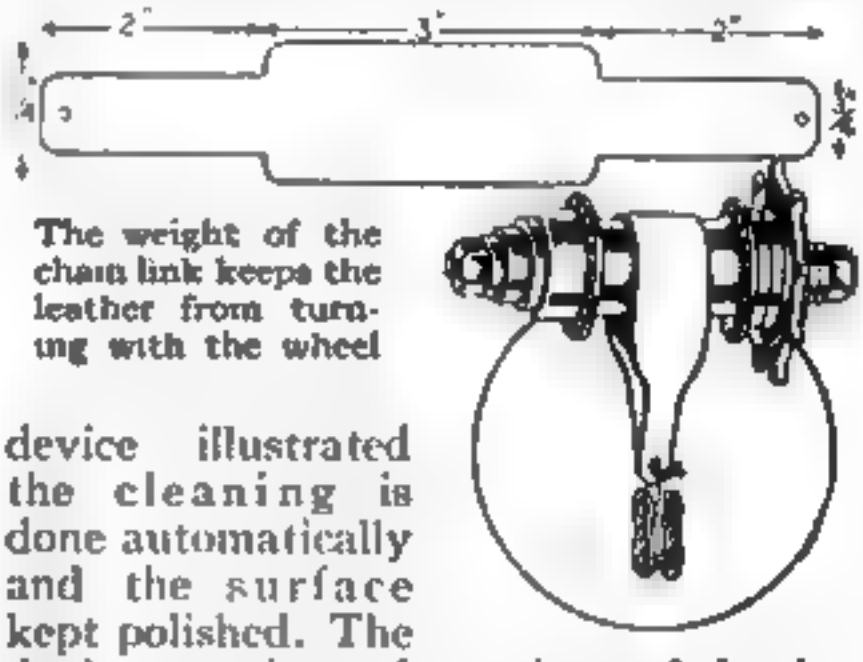
room where it is most needed. Strips of fairly heavy metal about 7 in. wide are cut as shown in the illustration. The back is turned in at an angle of 90 deg. and fits in behind the register. After the canopy has been bent into shape the screws in the register are loosened and the back slipped behind it. Then the screws are replaced.—E. C. STILWELL.

How to Straighten the Crooked Straws of a Broom

TAKE a pail of boiling hot water and completely immerse the straw end of the broom for ten minutes. After the straws have become completely soaked, withdraw the broom and suspend it by the handle. When the straws are dry they will be found to be perfectly straight.—E. HUNTSMAN.

An Automatic Cleaner for Bicycle Hubs

HUBS of bicycles readily collect dirt, and because of the spokes they are very hard to clean. With the little



The weight of the chain link keeps the leather from turning with the wheel

device illustrated the cleaning is done automatically and the surface kept polished. The device consists of a piece of leather shaped as shown, then hung over the hub, the ends being fastened with a link of chain. This link besides holding the leather on the hub is also convenient for repairing a broken chain in an emergency.—M. J. SILVERSTEIN.

An Improved Force-Filter Which Is Easily Cleaned

MOST force-filters, used for rapid quantitative work, catch the filtrate in flasks, which are often hard to clean after a filtration, especially if some of the precipitate passes through the filter-paper.

This disadvantage can be overcome by catching the filtrate in a beaker under a bell-glass, with a top for a two-hole rubber stopper. A funnel is inserted with a glass tube which is connected by means of a rubber tube to an aspirating-pump. If the suction is strong, a platinum cone should be placed in the funnel to prevent the paper from tearing. The glass or metal plate, upon which the bell-glass rests, should have a slight coating of some sticky, pasty material, such as that used on the disk of an exhaust pump, which will render the contact perfectly air-tight.—EDWARD MUTCH.

Plane Blade Clamp and Emery Wheel Guide

WHEN sharpening a plane blade or a chisel 1 in. or wider, it is difficult to obtain a true edge even when both hands are free; and since the advent of the small hand-power wheels it is still more difficult where only one hand is available for guiding the tool. The guide shown here is intended to counteract the difficulty.

Fig. 1. The clamp which holds the plane blade is made of iron with an oak sliding block

The clamp which holds the plane blade, Fig. 1, is made of iron, with the exception of a small oak sliding block. A strip of iron 8 in. long by 1½ in. wide and ⅛ in. thick can be procured at a hardware store or blacksmith shop. Heat it red hot and bend it over an anvil or vise to bring it to the necessary form, as shown in Fig. 1. When it is sufficiently cool touch up the rough surface with a file or emery wheel. Procure some ¼-in. round iron rods, cut them the required lengths, according to the design, and thread with a machine-screw die, ¼ in. by 20 or 24 threads. Make the holes for the adjusting screws with a 3/16-in. twist drill and tap them with ¼-in. by 20 or 24 tap. The handles on the screws are made of short pieces of nails set snugly in a ⅛-in. hole.

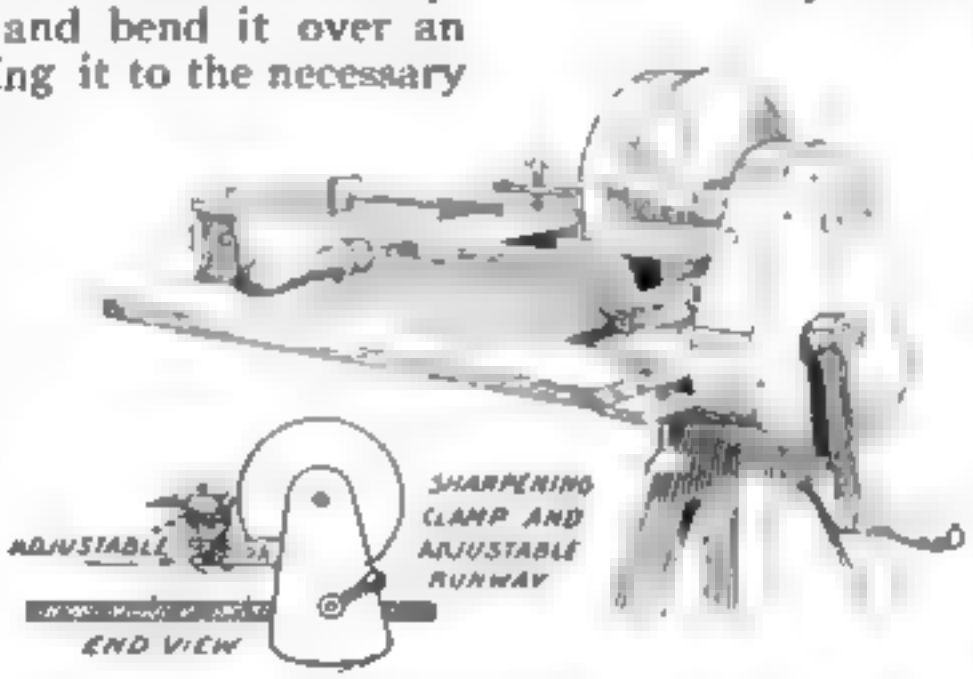


Fig. 2. The wheel is clamped to a board which may be used as a permanent base for stability

The sliding block of oak on the horizontal adjusting screw is about 1 in. by 1½ in., and perhaps ½ in. thick, allowing sufficient depth for the long screw to be seated in it. Make a small groove on the end of the screw nearest the block and put in a brad to keep the screw from drawing away from the block. Before attaching the block, rabbet the lower corner which will overlap the plane or chisel blade, or inlay a small strip of fairly stiff brass in the top of the oak block, setting it with glue, so as to form a wearing surface for the vertical screw, as when sharpening a narrow blade the oak block may come under the screw. In order to have the emery wheel and guide always in line and set up square it is well to have the wheel clamped to a board which can be used as a permanent base; then the device can be fastened to the workbench as a unit or hung out of the way when not in use.

The runway itself is made of wood, as the wear is very slight. It should be at least twice the length of the sliding clamp. Have it about 1½ in. wide by ¾ in. thick. With a rabbeting plane take off the top to the depth of ⅛ in., leaving a small raised edge about ⅛ in. by ⅛ in., which is to guide the clamp, as shown in the detail in Fig. 3. Another way would be to screw on a thin metal strip, raising one edge ⅛ in. above the top of the runway. Fasten a small angle iron at each end of the runway. Secure them to the sliding support on the right, and to a permanent support on the other end. Small bolts with thumb nuts will render the runway adjustable, so that a blade can be ground at any desired angle. The runway should be set up at a perfect right angle to the center of the wheel.

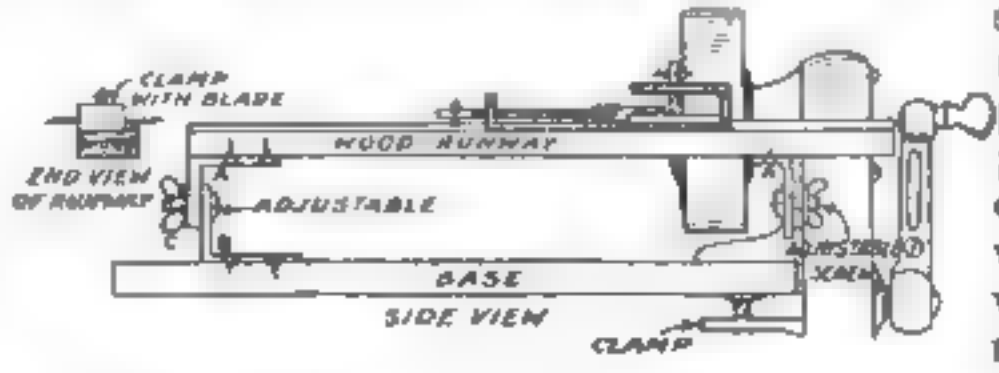
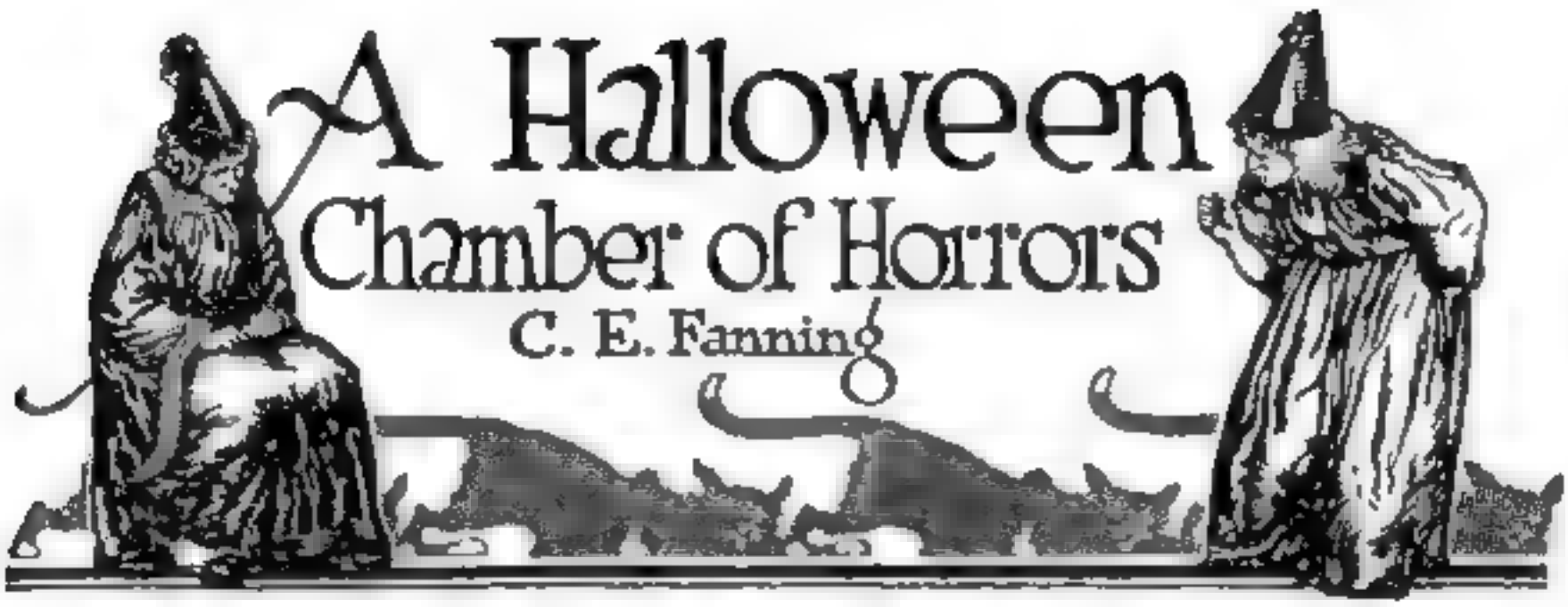


Fig. 3. The runway may be made of wood and should be twice the length of the sliding clamp



A Halloween Chamber of Horrors

C. E. Fanning

HALLOWEEN entertainments where young people of both sexes participate are usually characterized by merrymaking in which witches of a more or less friendly type are the principal feature; but where none but brave scouts of the *genus homo* are present, as at a club or a boys' school, the horrors may be as real as they can be made. The "Chamber of Horrors" described here was fitted up by boy students last October 31, and the thrills and shivers which the participants in the fun received are not yet forgotten. The materials used were borrowed from the school laboratory or from the students' homes. The experiences began at the very entrance doorway.

Beside the arch outside the entrance, which was draped with black crepe and surmounted by a sign reading, "The Cave of Death; All Hope Abandon, Ye Who Enter Here," stood a witch in skeleton mask and long black robes, who barred the way with a long dry bone, questioned each applicant as to his strength of nerve, and in serious tones made each assert that he entered the cave at his own risk and peril. Two raps from within the closed door signified that the victim had permission to enter. In the arch under which the victim passed hung a human skull and cross-bones, suspended by fine wires. Those who were curious to touch or handle them, received a moderately severe shock.

As the victim placed his hand on the knob to open the door, he received another shock and was commanded in hoarse whispers to close the door behind him. The room which he now entered was absolutely dark, except for phosphorescent hands here and there, and a phosphorescent skull near him. Before he had time to see them distinctly, something cold and flabby struck him in the face. A pair of the gleaming hands picked up the phosphorescent skull, and a voice whispered, "Take this baby's skull in your hands. Press it to your lips. There are maggots crawling on it—a-a-a-a-h."

After actually experiencing the revolting sensation of maggots crawling over his lips the victim was allowed to proceed. He was struck again in the face by something cold and flabby. A blinding light flashed in his eyes with a report like that of a pistol. "Look!" said a hoarse voice. Before him he saw an irregular-shaped greenish light, shining down upon some white object stretched upon a table. "A corpse," said the voice. One of the phosphorescent hands took his own and placed it on that of the corpse, which was cold and clammy, and also on the foot, which gave the same chilly thrill. From the dead man's side, a jack-in-the-box jumped in the victim's face. The flickering light died and the whispered voice commanded: "Proceed!" He passed between two phosphorescent snakes, crawling on tables. A door-knob glowed nearby with a phosphorescent light. From just above the knob, with a loud and continuous crackle, a 6-in. spark commenced leaping to a point by the side of the door. As soon as he started toward the door, this spark, which would really have been dangerous to receive, ceased, and when he went out of the door, he received the same comparatively mild shock he had

felt when he opened the first door.

Nearly all these effects, and a number of others, were produced by comparatively simple means. It is important to have someone in charge of the chamber who can talk—or whisper hoarsely and convincingly, in order to make a pound of raw beefsteak and a chunk of ice which are used occasionally sufficiently terrible. But, of course, the more mechanical and electrical effects there are, the better.

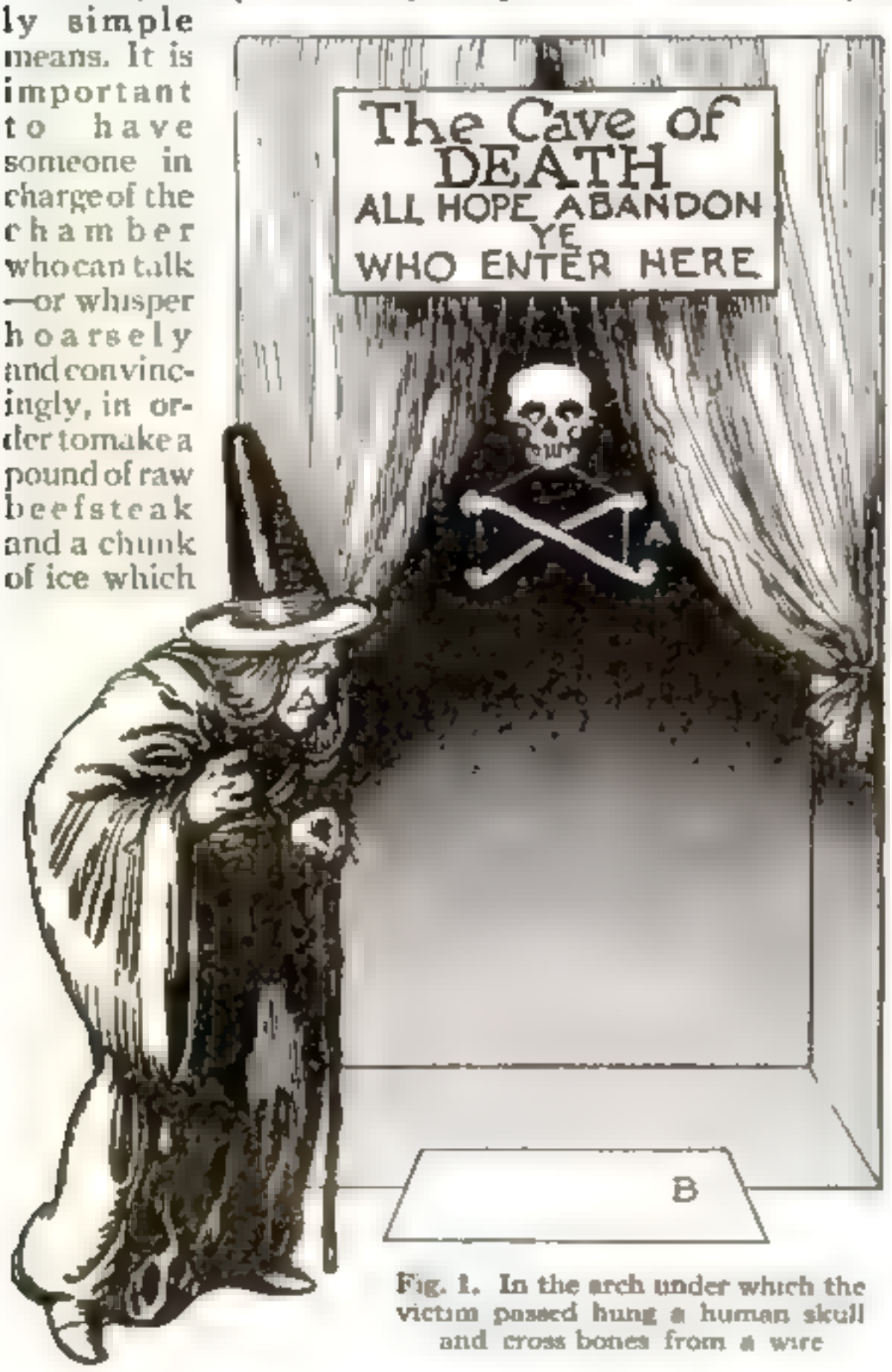


Fig. 1. In the arch under which the victim passed hung a human skull and cross bones from a wire

All the electric shocks came from a small but active induction coil operated by three or four dry cells. One pole of the coil was connected with fine wires that suspended the skull outside the entrance (Fig. 1 and Fig. 2, *A*), with the door-knob at the entrance (Fig. 2, *B*), and with the one at the exit *C*. The other pole was connected with a number of steel door-mats properly placed as *D*, *E*, and *F*

The flabby objects which strike the victim's face are merely rubber football bladders (hot-water bags would do as well) kept moist, and suspended from the ceiling at the average height of the face. They are merely drawn back and allowed to swing into the face of the victims (Fig. 3). It was necessary to use the scheme diagrammed because every movement of the phosphorescent hands was visible

The baby's skull was a papier-maché candle-shade picked up at a ten-cent store. The illusion of the crawling on the lips was produced as follows: The skull was coated with tinfoil which was connected with insulated wires to one of the poles on a medical coil, the other pole of which was attached to a metal floor-plate located where the victim would stand. The coil was tuned down so low that the shock could not be felt in any other part of the body except the sensitive lips, and gave them exactly the impression of numberless small crawling objects. The bright light which flashed in the eyes was merely a pocket flashlight; the sound which accompanied

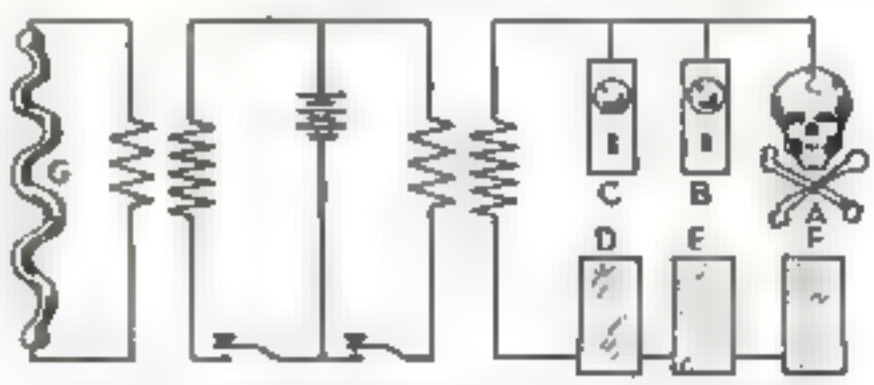


Fig. 2. Wiring diagram showing connections to the skull, door-knobs, plates, etc.

it was made by a sharp blow with a hammer on a piece of sheet-iron suspended from the ceiling.

The corpse was a pasteboard torso in the possession of the biological laboratory, but stuffed garments would have been just as serviceable. The weird light above it was produced by a Crookes' tube from the physics laboratory, operated on another small induction coil (Fig. 2, *G*). The dead man's hand and foot were of course a glove and stocking filled with wet sand. The snakes were real, but artificial ones would have served as well. The 6-in. spark above the door-knob, which was probably the only effect not available in the average high school laboratory, was produced by a large induction-coil operating on a current of about 50 volts, taken through a rectifier and a rheostat from an ordinary electric lighting circuit.

Fig. 3. Suspended air-bag of a football

Although there are a number of phosphorescent paints on the market, the paste used in this instance was made from the heads of three or four boxes of matches and a little water. Anything which is a sudden shock or surprise is valuable. Snakes, rats, bats, and anything suggestive of death or decay

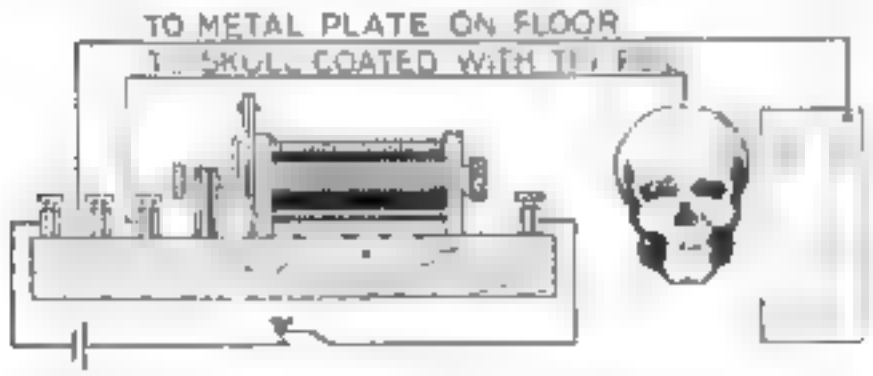
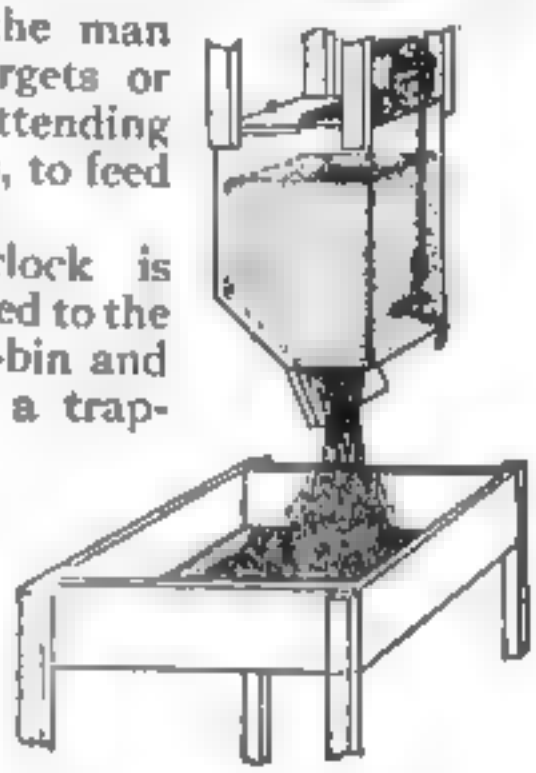


Fig. 4. Connection of the wires from the medical coil to the footplate and the skull

will arouse terror in most people; but one boy went through the entire chamber without having any impression made upon him. Just as he was going out the door, however, a terrified yell proclaimed that the big rattler had gotten loose in the darkened room. There was really no rattler in the room, but the boy went out thoroughly frightened at last.

An Alarm-Clock Dinner Bell for Old Dobbin

FROM the standpoint of the man about the house, the dollar alarm-clock has filled more long-felt wants than any other modern invention. In these columns alone articles have already been published telling how to open the furnace-door with an alarm-clock, how to control electrical toys with alarm-clocks, and a generous number of interesting and ingenious plans for awakening the entire family by alarm-clock systems. The latest alarm-clock idea will interest the man who either forgets or is too busy attending to other things, to feed his horse.



Tripping the trap-door with an alarm-clock

An alarm-clock is securely fastened to the top of a grain-bin and set to release a trap-door at a certain prescribed time. There is a small catch which allows the door to drop. This is operated by a cord running up to the clock and around the alarm-winding key. The alarm is set for the feeding time, and when the key revolves, the string is pulled, the door drops and the grain pours into the trough.

An Experiment with the Static Electricity from Belts

THE following is a little experiment with static electricity. Take an ordinary electric light bulb, grasp it near the tip, taking care not to get the fingers near the screw-socket on the other end, and hold the bulb near a slipping belt that is generating static electricity, so that the brass almost touches the belt. Sparks will be seen to pass to the bulb, which is then acting as a Leyden jar, and will hold a considerable charge, depending on the size of the bulb. The amount of the charge can very well be apprehended by touching the brass end to a water pipe.

Brackets for Double Sheets of Wrapping Paper

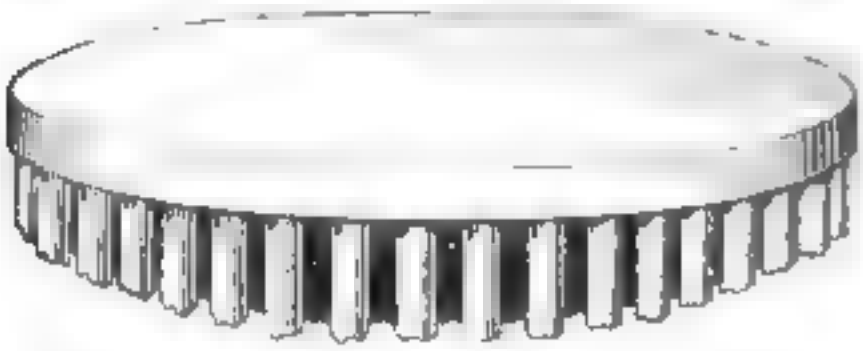
MANY storekeepers still use double flat sheets of wrapping paper, in bundles which are usually piled in some out-of-the-way place difficult to reach. A contrivance for holding this paper may be made as follows:

Two brackets fastened to the wall with holders for large sheets of wrapping paper

Fasten two iron shelf-brackets to the wall about 30 in. apart and 4 ft. from the floor. On top of each bracket screw a strip of wood 2½ in. square by 20 in. long; then nail a small strip 3 in. wide and ½ in. thick to the outer edge of each one of the large strips so that the small strips are ½ in. higher. Cut grooves with a half-round chisel or bore holes with an auger in the top of each large strip as far as the small strip. Iron rods the length of the distance between the strips can be inserted in the grooves with the wrapping paper hanging over them where they can be obtained quickly. The small strips nailed on the sides of the large strips prevent the rods from slipping out.—E. M. RITT.

Keeping Roasted Peanuts Hot on a Steam Radiator

IN THE front end of a confectionery store there was placed a large steam radiator made in a perfect circle of vertical pipes—one of the old-fashioned kind. The leaseholder of the room utilized the large volume of heat in a very unusual manner. Having a large trade in roasted peanuts and not caring to have the roaster in the front of the store the peanuts were kept hot in the bags on the radiator.



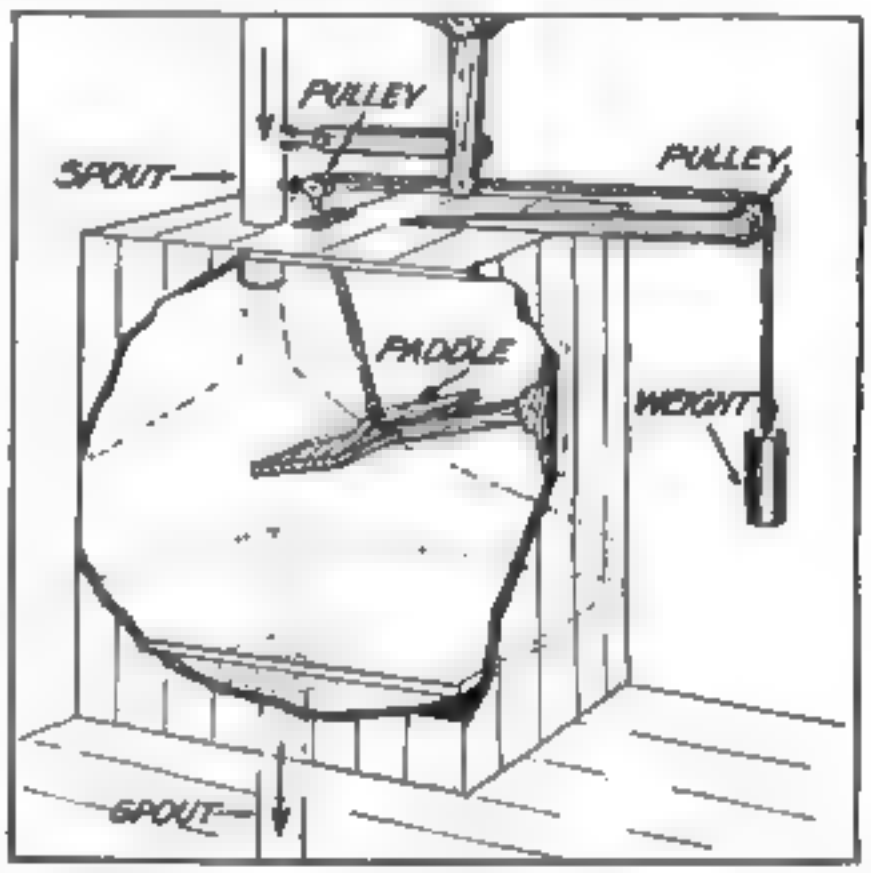
The heat from the steam radiator is sufficient to keep the roasted peanuts hot

To give this arrangement a pleasing appearance a large disk of galvanized sheet iron was cut and a tinner seamed it to an apron so as to make a huge "can cover" to fit snugly over the radiator top. The bags of peanuts were kept on this metal cover and served hot to the customers.

An Automatic Grain-Valve to Prevent Waste

A MILLER in a small flour mill had occasional trouble with a bin that was continually running over. By applying the device described the difficulty was overcome by stopping the flow of the grain automatically.

A paddle is inserted in the bin and a rope attached to it which is run over pulleys and fastened to a lever that opens or closes a slide valve in the grain spout.



When the level of the grain is below the paddle the weight opens the valve

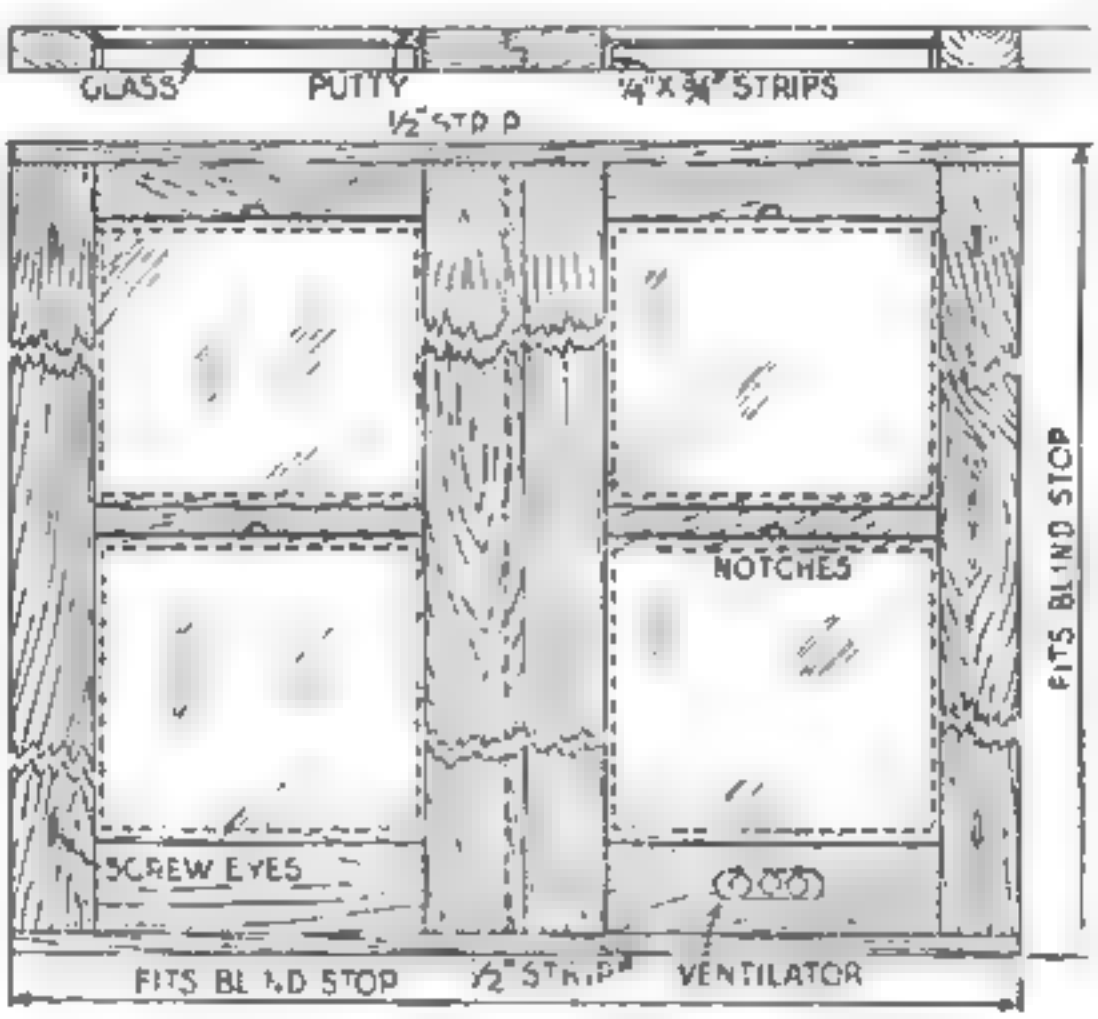
When the grain is running out of the spout it is naturally settling in the bin, and if the bin gets so full that it covers the paddle, the paddle is slowly pulled down with the sinking grain. After the grain has been shut off and the level is below the paddle, the weight opens the valve. A paddle with two square feet of surface will pull hard enough to break a small rope, so very little surface is required.—VICTOR PAGÉ.

Making Storm-Sashes from Old Shutter-Frames

THE owner of an old-fashioned house which presented several examples of architecture of a past age found a way to convert the shutters into a modern convenience.

He removed the slats, leaving the frame of each pair intact. These frames he fastened together at the meeting rails with long wire finishing nails to each piece. To further stiffen the frame, so as to keep it in line, 1 in. of the lower rail was sawed off and the space filled with two ½-in. strips nailed on at the top and bottom. All the blind hardware was removed. The scars resulting therefrom were smoothed over with a scraper and sand paper, and touched up with a priming coat of paint, after which all screw holes were puttied and blocks were fitted into the notches made to receive the end of the lifting rod when the shutter slats were closed.

This completed the frame except that there was no rebate to support the glass. Strips ¾ in. wide and ¼ in. thick were procured and cut to the proper lengths. These were fastened with brads around the inside of each opening for the glass to rest on when put in place. They were given a priming coat of paint so that the putty would adhere. The glass was ordinary single strength, known as "B" grade. This glass is not perfect, but it admits as much light as any other grade and it is inexpensive. For the ordinary window, four lights about 12 by 28 to 14 by 30 in. are required The latter size has 17 lights to the box; the smaller size, 20 lights. It will be necessary to cut these lights in almost every case, as the openings in the shutters are usually not made to glass sizes. For this purpose the ordinary steel six-wheel glass-cutter will be found satisfactory.



Old-fashioned shutter frames used for storm-windows by substituting single strength glass for the shutter slats

To cut the glass lay it on a flat-top table, large enough to support it with a margin all around. Pad the table surface with 3 or 4 thicknesses of newspaper, and on top of this put a sheet of stout wrapping paper, on which draw two strong pencil lines at exactly right angles. The lines form the gage. One corner of the glass is placed in the angle and two sides are made to agree exactly with these two lines. The opening should be measured in each case, and the measurement laid off on the paper so as to be seen through the glass This should be done for each panel, as they may vary slightly in size. Cut about 1/16 to ⅛ in. scant of each measurement to prevent the glass from binding in the frames.

Use a strip of wood not less than ½ in. thick for a straight edge and have it long enough to gage the longest dimension without shifting. Measure the thickness of the cutter-block carrying the wheels. Put the plain side against the straight edge and allow for the thickness of the cutter-block. Dip the cutter-wheel into turpentine and make a quick stroke from end to end of the glass. Never run over the cut a second time. A piece of cardboard should be provided having a thickness equal to that of the glass. It should be placed at the end of the cut to prevent break-

age there. Cut both edges in this manner; take the glass up in the hands with one thumb on each side of the cut and a folded first finger of each closed hand underneath, then bend sharply upward. The cut will part its entire length, clear and clean. Out of 80 lights cut in this manner only two were broken. Occasionally a pane will appear to be cross-grained and will not break clean. In this case "nibble" the edge down with a pair of flat nose pliers. Never use the slots on the cutter unless you are expert in the use of them. Practice some cuts on waste glass before starting to cut the stock.

After the glass is cut, it is set, fastened with glazier's points and puttied in the usual manner. To make it fit the frame snugly so that it will be air-tight, putty should be placed in the rebate first before setting the pane, then each pane is fastened by laying a glazier's point on the surface and driving it in with the side of a chisel, swinging the bevel part back and forth in contact with the glass. Do not set the panes too tight or they may break. Some allowance should be made for expansion. If the putty is too stiff soften it by adding some linseed oil and kneading it in the hands. If too soft and sticky add a little powdered whiting and work it in the hands to the proper consistency. When the joint is finished run the finger firmly but lightly around on the putty to smooth it and make it pack properly. The touch is quickly learned after a few trials. When the putty has set, say 48 hours, the glass should be cleaned with alcohol and water and given the final coat of paint.

When this is dry the hanging operation takes place. For all second-story windows, hangers should be used. To locate the hangers use a dummy frame, to which hangers have been fastened with screws in the proper position. With this the hooks in which the hangers engage are easily placed on the window-frame head without handling the heavy sash in each case. The lower windows may also have hangers if desired.

Improvised hangers may be made of brass screweyes turned into the inside of each frame about 10 in. from the top and bottom in such a way that when the sash is in place a 4-penny nail, driven through the screweye and into the side of the window frame, will make a tight fit. This, of course, makes no provision for ventilation; but a ventilator may be made in the bottom of each sash by boring three 1-in. holes side by side. A shutter of galvanized iron pivoted at one end, covers these holes when required, or may be swung aside on the pivot to open them. When open, with the upper sash lowered, the desired ventilation is obtained without draft. A screweye, located opposite the pivot, could be turned to fasten or release the metal shutter.

The sashes on the upper windows of the house in question were provided with hangers for ease in handling, and they also had screweyes for fastening the sash permanently. A button-hook was used to pull the sash up tight, by hooking it into the screweye while the nail was being driven. When all were in place the sashes were calked to the frames to make them air-tight. Strips of cloth about 1 in. wide were used. These were pushed in with a thin-bladed putty knife until no draft could be felt when the hand was held to the calked crack.

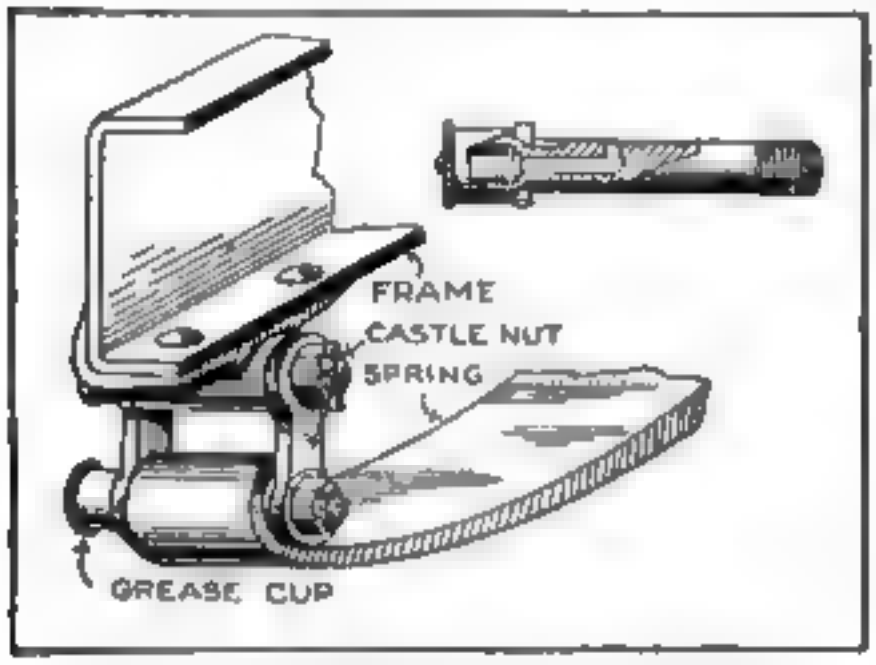
If for any reason it is not desired to use the blind frames as described, the frames can be made from new material, or that which may be gathered around the scrap pile. An old hotbed sash will furnish the material for a very satisfactory storm-sash frame. It is not necessary to use mortised joints. The corner joints may be made with lapped ends and the mullions nailed in place. Of course, the built-up frame will admit more light than the one made from a blind frame, but otherwise it has no advantage.—H. S. Tallman.

Getting Maximum Service from a Typewriter Ribbon

TYPEWRITER ribbons that have been worn out may be used again by making the ribbon double and winding it on the spool. It will give considerably more service and will write with much of its original clearness. On a typewriter that has average usage this hint will save several dollars in the annual ribbon bill.—J. Arthur Reid.

Lubricating Automobile Spring Shackles and Bolts

SPRING shackles, or hangers, are good examples of automobile parts that are obscured by other parts so that they are sometimes overlooked or forgotten when oiling time comes. These joints form the connecting links between the springs and the frame, and they must support the weight of the frame, motor, body and passengers. The length of the spring varies with the degree of deflection, so that the spring shackles swing back and forth, developing friction at all joints. To prevent the wear on these bearings it is necessary to provide an ample supply of lubricant. These joints are partly, if not wholly, covered by the front and rear fenders, and failure to care for them properly is often the cause of annoying squeaks and rattles.

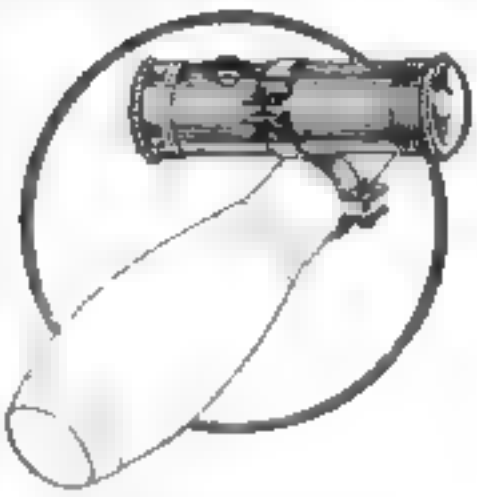


Grease is forced through a hole drilled in the bolt that secures the cup in its place

A simple method of lubricating them employs the grease-cup as illustrated in the drawing. A small hole is drilled in the bolt connecting the grease-cup with the center of the bearing surface. The grease is forced through this hole to the bearing surfaces when the cup top is screwed down. The cups should be filled with a good cup-grease and then turned down until the lubricant is forced out to the bearing. This should be done after every 500 miles; or, better still, on a certain set day each week. At least once a season the spring bolts should be removed and thoroughly cleaned. The hole through which the grease is fed should be cleaned out with a wire and flushed with gasoline.

A Pocket Flash-Lamp on the Bicycle-Handlebar

A SIMPLE and inexpensive bicycle light may be made by welding together two hose-clamps, such as are used on garden hose, one clamp being fastened to the handlebar and the other to a pocket flashlight, as shown. The two clamps should be riveted together and then welded with oxy-acetylene or brazed. A flashlight mounted in this way gives very good service.

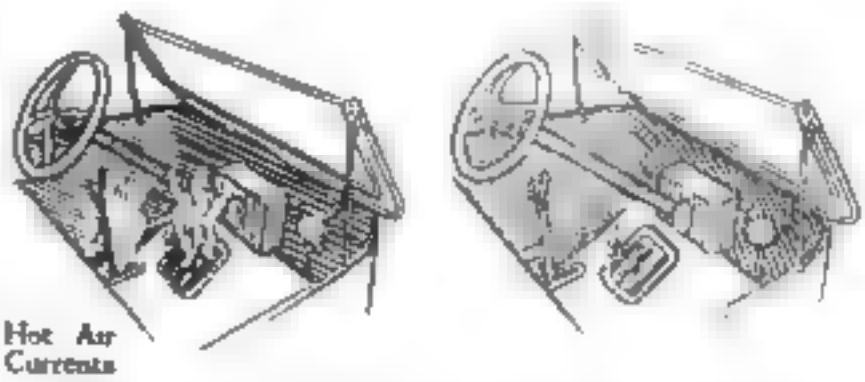


Two hose-clamps on a flash-lamp holder

Fillers for the Pedal Slots of Automobiles

THE front seats of an automobile, while highly prized by everybody, are not usually the most comfortable, because in summer the heat of the motor is felt through the floor-board and in winter the cold is more perceptible there. This is especially true of the Ford car, which has four large slots in the floor-boards, where the pedals and brake-lever are located.

To close these slots a simple filler plate has been devised, which fits under the floorboards and holds a piece of rubber over the openings. The rubber sheet is slit to allow the shanks of the pedals to pass through so as not to interfere with their operations; but the slits are barely long enough to serve their purpose leaving no space for air to enter.



Slots of a pedal plate covered by a rubber sheet so as to prevent unpleasant drafts

Asbestos felt boards may also be used to insulate and make draft-proof the under sides of the floor-boards.

Estimating the Speed of Passing Automobiles

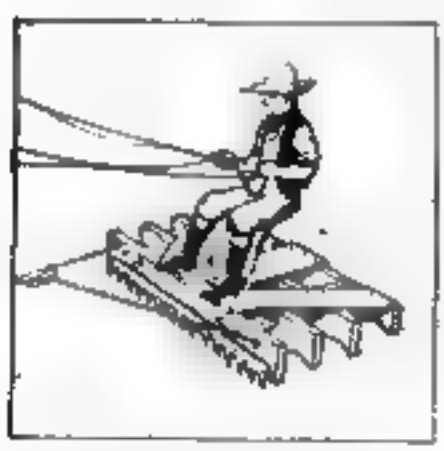
YOU can calculate the speed of passing automobiles, without leaving your house. Measure off 132 ft. on the street, marking each end with slacked lime. With a little practice, it will be possible to note, on the dial of a watch, the exact time taken in traversing this distance. The following table shows the rates of speed:

1 Sec.	90	miles per hour
1½	60	" " "
2	45	" " "
2½	36	" " "
3	30	" " "
3½	26 +	" " "
4	22 +	" " "
4½	20	" " "
5	18	" " "
5½	16 +	" " "
6	15	" " "
7	13	" " "
8	11 +	" " "
9	10	" " "
10	9	" " "
11	8 +	" " "
12	7 +	" " "
14	7 +	" " "
15	6	" " "
18	6	" " "
20 "	4½	" " "
22	4 +	" " "
25	3½	" " "
30 "	3	" " "
45 "	2	" " "

A series of tests showed the average speed of an automobile to be 6 sec.; horse trotting, 14 sec.; a man walking, 30 sec.; a woman walking, 45 sec.—D. L. MERRILL.

A Practical Pulverizer Made From a Cutter-Bar

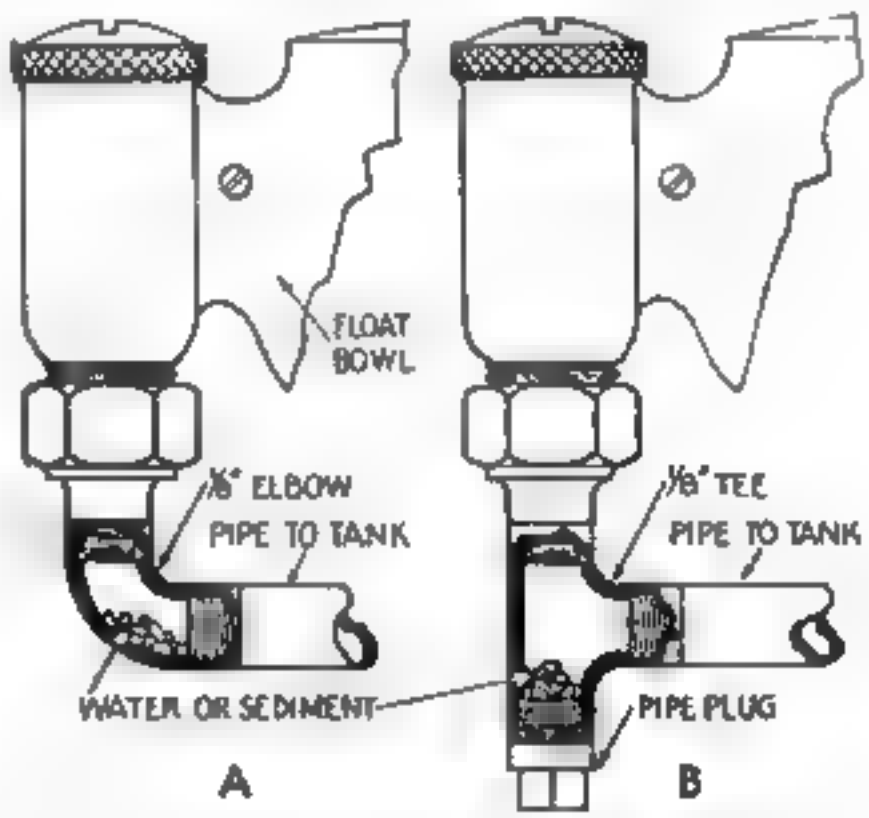
THE illustration shows a pulverizer to crush clods and pulverize the ground. It consists of a cutter-bar taken from an old binder and bolted to the front member of the ordinary road drag. The bar is placed at an angle so that the trash will not hang upon it. The guards of the bar will penetrate the ground, break up the clods and smooth the ground very satisfactorily.



Binder cutter-bar on front crosspiece

Making a Sediment Pocket in Feed Line to Carburetor

NO MATTER how carefully fuel is filtered when filling the automobile or motor-boat tank, a certain amount of impurities will be poured in with the gasoline, which the ordinary fuel filter using wire gauze screens does not prevent from reaching the carburetor. While a screen will retard lint or scale, it will permit particles of rust or small drops of water to pass through. If the gasoline pipe is joined to the carburetor with an elbow, as shown at *A*, the dirt or water



A tee joint in the line below the carburetor forms a place to catch the sediment

is apt to collect, resulting in erratic engine operation because the flow of gasoline is impeded and at times interrupted altogether.

The method shown at *B* is a superior one. A tee-fitting is used instead of an elbow and the open end is plugged with a standard pipe plug. Impurities then collect in the bottom of the tee instead of flowing into the carburetor or constricting the passage. A piece of pipe 1 or 2 in. long, capped at the end, may be substituted for the pipe plug. This gives a larger sediment chamber; or a standard petcock may be used at the bottom of the tee, providing a means of drawing off the dirt readily.

THE value of millstones produced in the United States dropped from two hundred thousand dollars in 1880 to forty-three thousand dollars in 1915.

A Four-Family Apartment House

By George M. Petersen

THE four-family apartment house, and apartment houses in general, are, properly speaking, tenement houses and are so classed under the rules of the Board of Health and Bureau of Buildings in most of the cities of this country. While the origin of the four-family apartment is somewhat mysterious, it was probably designed by someone who wanted the class of tenants known in the large cities as "flat dwellers" and who also wanted more rents than could be obtained from a two-family house. The modern four-family apartment is nothing more nor less than two two-family houses joined together on a common wall.

The wall dividing the house in the center is of either fireproof or fire-resisting material; such as hollow tile, old brick, concrete blocks or stone, although the hollow tile is the most commonly used. This fireproof wall extends the entire length of the house and from the cellar floor to the ridge of the roof without an opening of any kind except a fire-door in the cellar and the entrance doors to the apartments.

The building shown in Fig. 1 is 32 ft. wide by 72 ft. long and is built on a lot 55 ft. wide by 160 ft. deep.

The living-rooms and dining-rooms in this house are finished in a fumed oak effect, while the bedrooms and bathrooms are either natural oak or white enamel. The rear halls may be finished in the same kind of wood as that used for the bedrooms.

Bathroom floors should be of hard lozenge tile to prevent the absorption of water, but should never be glazed, as the constant wear and tear to which the average bathroom floor is subjected will crack the glaze and disfigure the floor.

The floors throughout the remainder of the house should be of oak, with the exception of the kitchen floor, which may be of maple.

With a properly constructed house a four-family apartment is as desirable as is a two-family flat and has the advan-

tage of being more economical to heat, especially the lower floors. For this type of dwelling, the individual plant is the most satisfactory. In Fig. 2 is shown a plan of a cheap four-family apartment such as is usually erected in the less restricted sections of a city. This house is 10 ft. narrower than the one shown in Fig. 1. Although the buildings are the same length, exclusive of verandas, the plan shown in Fig. 2 is considerably cheaper to erect, not only on account of the 10-ft. saving in width but because of the perfectly plain roof and other differences where cost is the chief consideration.

The foundations of this house are of concrete blocks laid on a 6-in. footing of concrete. The fire-wall divides the house in the middle of its length instead of the center of the width as in Fig. 1. This fire-wall must be constructed in the same manner as is the wall in Fig. 1, extending from the foundation wall to the ridge of the roof without openings of any kind through which fire could communicate from one part of the house to the other.

The floors in the living-room and dining-room are of ⅜-in. tongue and groove "select" oak, while the remainder of the flooring is ⅞-in. tongue and groove yellow pine. The kitchens are wainscoted with ⅜-in. yellow pine, 3 ft. high, and finished at the top with a suitable cap, while the bathrooms have a 4-ft. wainscot of stamped metal tiling.

The refrigerator space is provided in the rear-stair hall, a galvanized iron pipe being placed in the partition so that the water will run away into the floor drain in the cellar. As will be noted from the plan, this house is provided with two verandas, each of which has a deck for the use of the second floor tenants, the decks being covered with canvas, which is much more satisfactory and durable than tin.

In the basement of this house are four hot-air furnaces, and instead of the automatic water-heaters of the more expensive plan, thirty-gallon range boilers are installed in each kitchen.

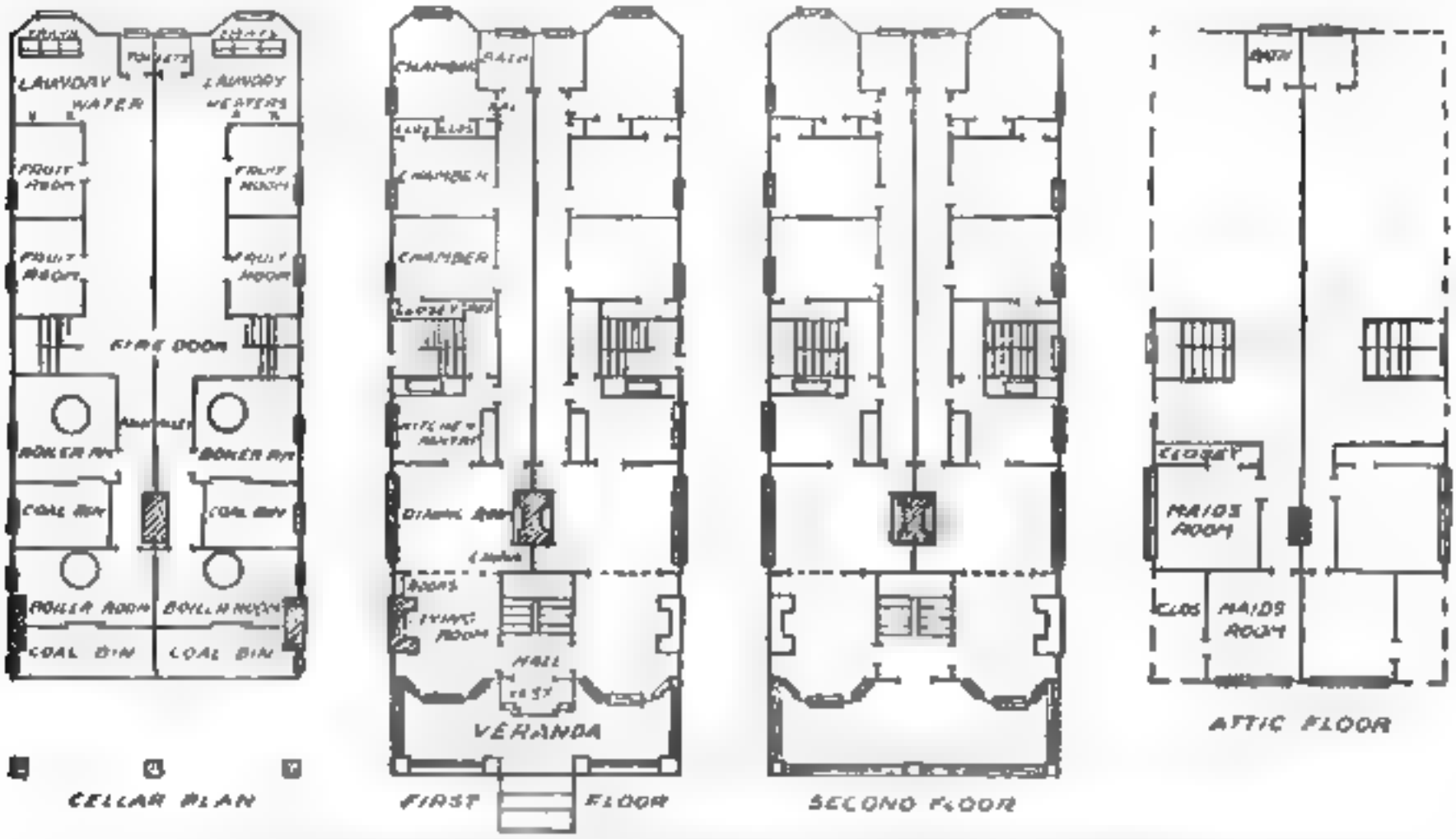


Fig. 1. Plan of a four-family house in which every room is an "outside" room and each apartment is self-contained, even the cellar being divided into separate compartments

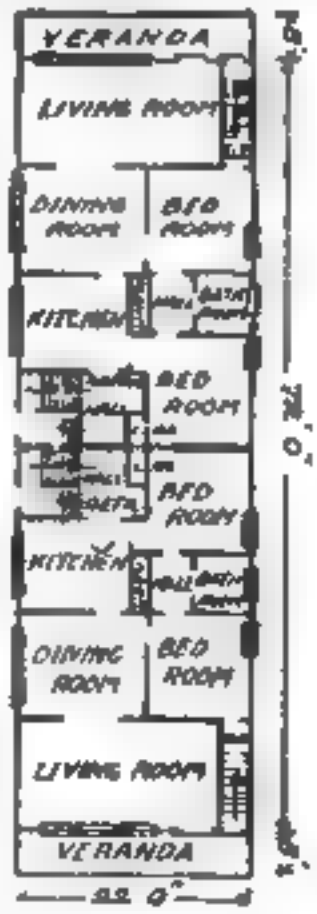
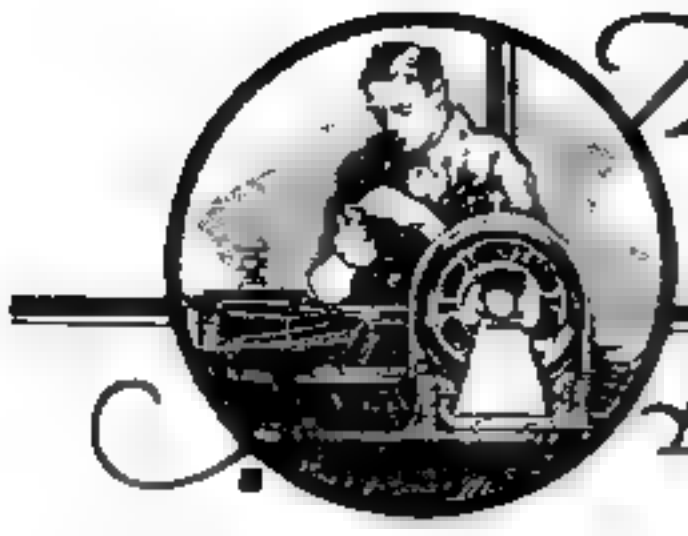


Fig. 2. The cost of this house is comparatively small



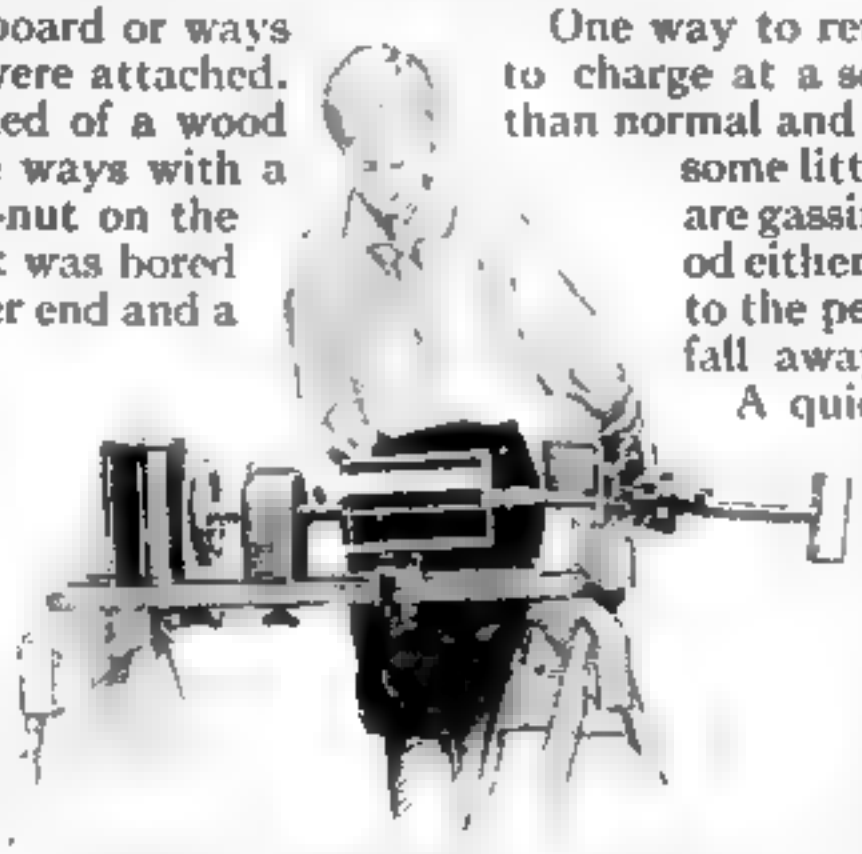
The Amateur Electrician

And Wireless Operator

An Improvised Coil Winder for Electrical Apparatus

COIL winding is a very difficult operation for the amateur, especially where it is desired to have the outside surface smooth and neat. To do it correctly the spool upon which the wire is wound must be revolved at a medium speed while the wire is fed on with a guide or by hand.

The work of winding some coils 10 in. long was quickly accomplished by the aid of a machine made as shown in the illustration. Two trestles were used to which a baseboard or ways of the devised lathe were attached. The tail-stock consisted of a wood block fastened to the ways with a bolt having a thumb-nut on the underside. The block was bored centrally near its upper end and a bolt placed in it with a waste nut screwed to one surface for the feed. A hand-wheel found in the scrap served to turn the bolt. The end of the bolt was filed down to a point for the dead center.



Winding an eighteen-inch coil on an improvised lathe made of a breast drill

The lathe-head consisted of a breast drill attached with clamp-bolts to a piece of the proper height fastened to the opposite end of the ways. A spur center was used in the drill-chuck for turning the spool. Spools of varying lengths can be placed between these centers and turned by means of the crank on the drill.

In winding the coil the ordinary wood rest can be used as a guide for feeding the wire.—WILLARD GEORGE COOK.

De-Sulphating Storage-Battery Plates

ONE of the chief causes of loss of efficiency in lead accumulator cells is sulphation. White sulphate of lead usually forms on the active material and at a point where it is least wanted—at the junction of the metal supports and the peroxide. The formation of this sulphate is due either to the impurities in the oxide employed, foreign substances in the lead or lead alloy, or chemical impurities in the sulphuric acid or water.

One way to remove the sulphate is to charge at a somewhat higher rate than normal and to continue charging some little time after the cells are gassing freely. This method either reduces the sulphate to the peroxide or causes it to fall away from the plate.

A quicker and more satisfactory way, however, is to add about 1 oz. of sodium carbonate (Na_2CO_3) to each cell. This not only reduces the tendency of the elements to sulphate, but rapidly removes the salt that is already formed. If the amount mentioned does not result in removing the sulphate, another ounce can be added to each cell; but no more than this should be put in. Unless the cell is in a very bad condition 1 oz. will usually do the work. After putting in the sodium carbonate, the cell or cells, should be charged at a rate of from 13 to 15 amperes for 8 hours.

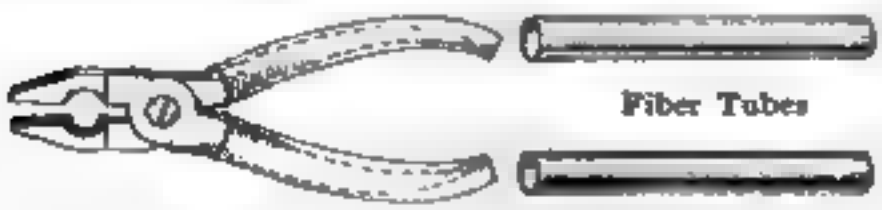
The de-sulphating solution should be mixed with a varying amount of water, de-

pending upon the form of the salt. If the crystallized salts are secured, they should be mixed with 1 part of salt to 2 parts of warm water. If the dry salts are used, 1 part of salt should be mixed with 5 parts of warm water. It is best to mix the solution immediately before using.

If storage-cells have been idle for some time and have become badly sulphated, the following treatment will ordinarily put them in condition for service again. First, the jars should be thoroughly cleaned and the plates dusted, after which the cells can be assembled and the jars filled with electrolyte, having a specific gravity of about 1.215. Cells can then be charged at 15 amperes for about 2 hours, after which ½ pt. of a strong solution of sodium carbonate mixed with 1 part of salt to 2 parts of water can be added. If the cells have been standing idle for a great length of time it is better to mix the solution with 1 part of salt to 1 part of water. They should then be charged at a rate of from 12 to 15 amperes for 8 hours a day for 2 consecutive days. The plates will look to be as good as new after the sulphate has been removed by this method. It is better to remove the de-sulphating solution after the plates have been brought to a healthy condition and replace it with the ordinary electrolyte.—A. GEMMELL.

Insulated Plier Handles with Fuse Cases

ELECTRICAL men are often called upon to make taps or splices on wires carrying current. For this work they need insulated plier handles. A simple method of making these is shown.

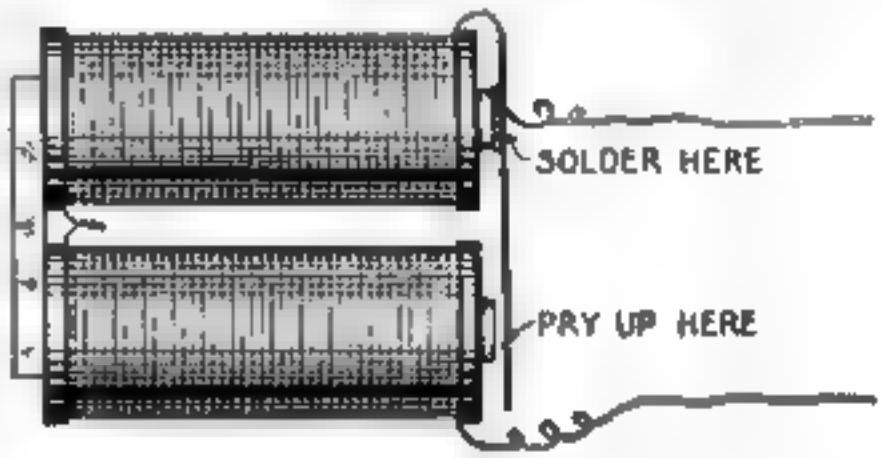


Fiber tubes driven over plier handles to form an insulation for electrical work

Take two fiber tubes such as are used in 600-volt fuses of about 30 amperes capacity. These can be forced over the handles if they are driven by light blows of a hammer. A fiber or wood plug is inserted in the ends and then shellacked or compounded. The result is a very good pair of insulated pliers.

Making an Alternate Current Buzzer From Old Bell Coils

TAKE two old bell coils and mount them on a wood base. Also secure a piece of heavy clock-spring

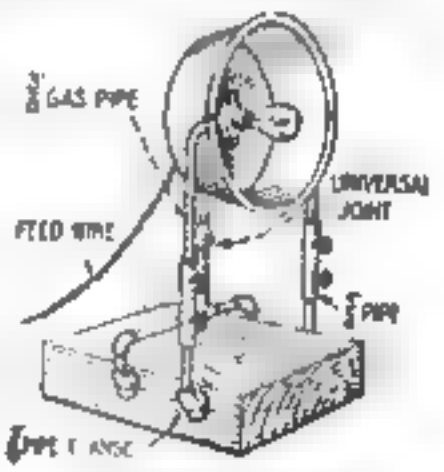


Buzzer made of old bell coils to work on alternating current

long enough to reach from one core to the other. Solder one end to one core and with a knife pry the other end so it will not touch the core. Join the inner wires of the coils together and the instrument is complete.—CHARLES LOOMIS.

A Home-Made Flood-Light Projector for Construction Work

THE accompanying illustration shows a home-made flood-light projector with the reflector made of an ordinary tin pan. The tin is large enough to permit using a 500-candle-power nitrogen-filled lamp, which is mounted in the center, as shown. The tin pan is supported by means of a ⅜-in. gas pipe in such a way as to permit adjustment of the projectors up and down through various angles. The two pipes in the front of the projector are fitted with sleeves and two wing-screws, which permit them to be shortened or lengthened. The rear pipe is arranged with a universal joint, which acts as a hinge. The universal joint could probably be dispensed with by using a loose tee at the bottom of the rear pipe.



A flood-light for night workers

How to Become a Wireless Operator

III.—The Construction of a One-Mile Receiver

By T. M. Lewis

IT IS most important for a student of wireless telegraphy to learn all about the operation of the various forms of receiving apparatus. The best way to become familiar with the instruments is to build and operate them. The simple buzzer-sender and microphone receiver which were described in the first article of this series served to illustrate the principles which are followed in all wireless apparatus, but were of such small signaling range that they could not demonstrate fully the details of modern instruments. The one-mile transmitter shown last month, however, when used in connection with the receiver now to be explained, is of sufficient size to approach the conditions of operation existing in commercial radio stations. By studying its action carefully the experimenter can learn much which will be of inestimable value to him in his later practice of wireless telegraph operation.

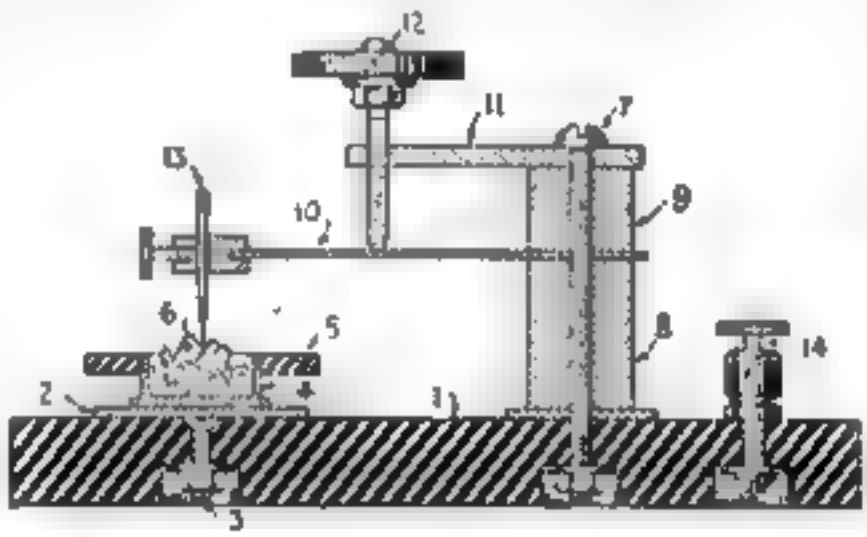


Fig. 1. A cross-sectional view of a crystal detector stand that is easily constructed

The student should remember that the use of a transmitter as powerful as that described in the second article, even though it is a very small one when compared to some of the great commercial plants, may cause interference at nearby receiving stations. He should therefore be very careful to observe all of the regulations and courtesies as to transmitting, and should send only when he actually has a message which he wishes delivered to his communicating station. One of the first habits which a successful wireless operator should cultivate is to refrain from sending except when it is absolutely necessary. Testing of the spark-gap should be done with the aerial disconnected, and code practice should be carried on with buzzers. There is never any objection to the amateur who sends actual messages with a wavelength of less than 200 meters (the range assigned to amateur stations by the Government) but the man who keeps tapping his key and sending out interfering waves which hold up legitimate messages soon becomes extremely unpopular with both the serious amateurs and the professional operators.

The Detector

Probably the most important element of any receiving outfit is the detector, which is an instrument for converting the received high-frequency current into pulsations which operate the telephones. The microphone which was described in the first article is a wave-detector of a very easily constructed type, and is always worth remembering for use in an emergency. It is very delicate, but is not so reliable nor so sensitive as the crystal detector which is illustrated in Fig. 1. A well made crystal detector is about the best instrument for all around use that can be had. Apparatus of this type is installed at by far the greatest number of commercial radio stations, and every operator should be familiar with its adjustment and use.

A side view of a detector-stand, which has been found very satisfactory in practical work, is shown in Fig. 1. The construction should be clear from the drawings, and a brief description. Dimensions are not given, since it is usually most convenient to modify them slightly

to suit whatever material may be on hand. The base 1 may be made of hard rubber, fiber or hardwood, and should be about 4¼ in. by 2 in. by ½ in. thick. Four holes to take 8-32 machine screws

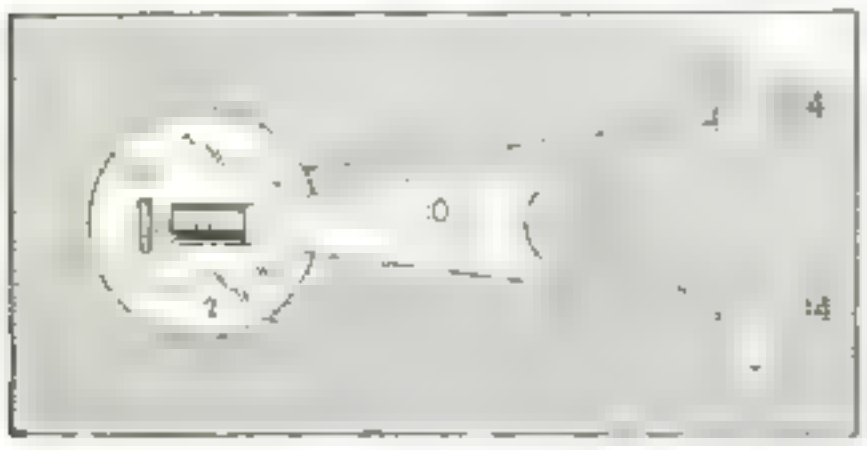


Fig. 2. Plan view showing the mounting of the spring brass that holds the needle

are drilled in the positions shown in Figs. 1 and 2 and directly beneath the parts and are counterbored from the bottom to about ¼-in. depth to take the nuts and washers. A disk 2, of copper or brass about 1/16 in. thick and 1¼ in. in diameter, is soldered to the head of a machine screw 3 and forms a sort of table on which the crystal-cup may slide. The screw 3 is fastened in place by a washer and nut, as indicated, and is connected to binding post 14 through the channel shown in dash lines in Fig. 2.

A flat brass cup as at 4, Fig. 1, ⅝ in. in diameter and ¼ in. deep, may be made by cleaning out thoroughly the cap of a shotgun shell. In this is secured a piece of fused silicon, galena, or other sensitive crystal 6 (which may be purchased from almost any wireless supply house) by melting and pouring in solder around it. The heat of molten solder will partially destroy the sensitiveness of some crystals, so it is better to use Woods' metal or a mercury amalgam if it can be obtained; solder will generally do for silicon, however. A hard rubber or fiber ring 5, about ⅛ in. thick, should be forced on over the outside of the completed cup, so that the crystal may be moved around without making contact between the metal cup and the operator's fingers.

A needle point 13 is to be supported directly above the crystal, and this may best be done by the pillar arrangement shown. A long machine screw 7 is passed down through two bushings 9 and 8, and is fastened below the base by a nut and washer. Between 8 and 9 is clamped a tapered strip of spring-brass 10, to one end of which is soldered a binding-post from the zinc terminal of an old dry cell. The shape of this strip may be seen in Fig. 2, where the upper part of the detector is omitted.

At the top of the pillar is fastened the adjustment arm 11, which should be made of brass about ⅛ in. thick cut as shown in Fig. 3. The left hole is threaded to take the pressure-adjusting screw 12, Fig. 1, and is slit as indicated at 15, Fig. 3. Thus the screw 12, Fig. 1, may be held snugly by the screw-threads. A hard rubber or fiber hand-wheel should be affixed to the top of 12 by a washer and nut, as in Fig. 1. Connection is made from the screw 7 to binding-post 14 by way of the shorter channel indicated by dash lines in Fig. 2.

The Telephones

Next to the detector, the most important thing in the receiving station is the telephone. Any ordinary telephone-receiver will give some sort of results, but to get the loudest signals for any particular set of conditions the best telephones should be used. There are on the market a number of head-receivers, designed for wireless telegraph use. These are usually mounted in pairs, one for each ear, on a flexible headband, and are wound for resistances higher than ordinarily used in wire telephony. Reasonably good results can

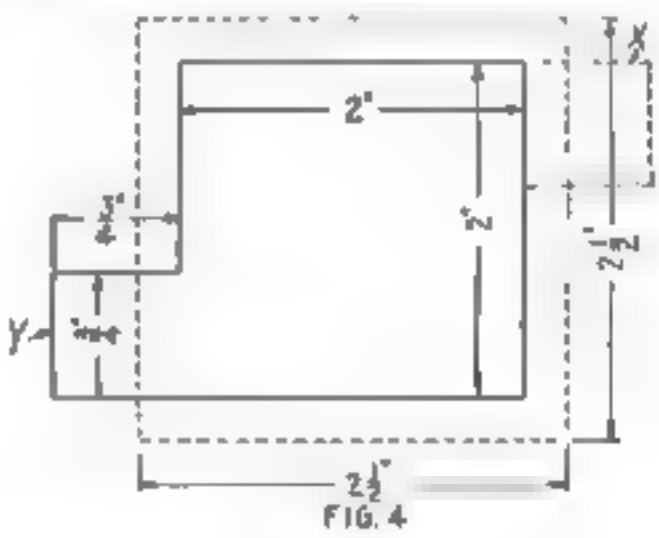


Fig. 3. Plan of the adjustment arm
Fig. 4. Detail of pattern of the tinfoil

be secured from two ordinary 75-ohm watchcase receivers, if they are connected in series and mounted upon an improvised headband. Thus, there is no need for any one to be discouraged

by the high price of the most expensive types. It is good policy, however, for the student to invest as much as he can spare in good telephones, even if a saving must be effected by cutting down the size of the transmitter.

The Blocking Condenser

Another essential part of the receiving apparatus is a blocking condenser, which is used to prevent the tuning coil from

Fig. 5. One of the holders for the condenser made of hard rubber, fiber or wood

short-circuiting the detector or telephones. Such a condenser as shown in Figs. 4, 5, and 6 may easily be made. A "fixed condenser" may be purchased from any wireless supply store, but it is a good plan for the experimenter to make one. By doing so not only is the actual construction of the instrument learned, but the weak points which might cause trouble later are located.

A pattern for the tinfoil sheets is cut as shown in Fig. 4, 2 in. square but each having a lug ¾ in. square at the corner. Thirty of these will be needed for the condenser. It is also necessary to cut out about thirty-five sheets of thin paraffin paper 2⅛ in. square, as shown by the dash lines in Fig. 4. The condenser is begun by placing a sheet of paraffin paper upon a flat surface, and putting on top of it one tinfoil sheet with the lug at the lower left corner, as shown by *Y* in Fig. 4. On top of this foil is placed a sheet of paraffin paper, and upon it a second sheet of foil; this time the lug is turned to project at the upper right corner, *X* (dotted lines) in Fig. 4. Then a sheet of paper is added, and upon it a third piece of foil with its lug in the *Y* (lower left) position. Another sheet of paper is put in place, and then a fourth piece of foil with its lug in the *X* position. Thus paper and foil are alternately added, and the position of the lug changed each time. The result is a pile of thirty sheets of tinfoil separated by thin paraffin paper, fifteen lugs projecting to the left and the fifteen alternate lugs projecting to the right. Care must be taken that none of the alternating sheets of foil touch each other, since this would short-circuit the condenser.

A holder for the paper-and-foil condenser is made by cutting out two pieces of ⅜ in. or 3/16 in. hard rubber or fiber or hardwood about 2¾ in. by 4 in., and drilling four holes in each as shown in Fig. 5. An 8-32 machine screw is passed through each of these holes, washers being placed between the clamping pieces in such number that the condenser is firmly gripped. The upper right and lower left screws *X'* and *Y'* clamp the groups of tinfoil lugs *X* and *Y*, as shown in Fig. 6, and the binding posts *X''* and *Y''* mounted upon their upper ends serve to make electrical connection. The other screws 16 and 16' are merely for mechanical strength.

When the condenser is finished, paraffin may be melted and poured in to fill the entire space between the two clamping plates. If the construction has been careful and if the condenser is in good condition, when a dry cell and telephone are connected in series with the binding posts *X''* and *Y''* only a very faint click will be heard as the circuit is made and broken. If the condenser is short-circuited (and therefore useless until repaired) the telephone will click as loudly with it in series as when connected directly across the dry cell

Additional Apparatus

In the next article there will be described the buzzer-testing arrange-

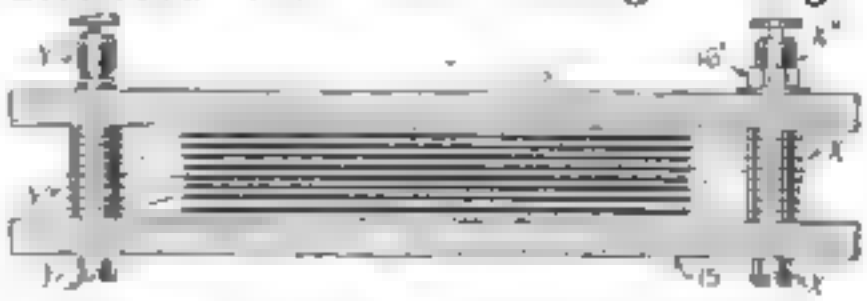


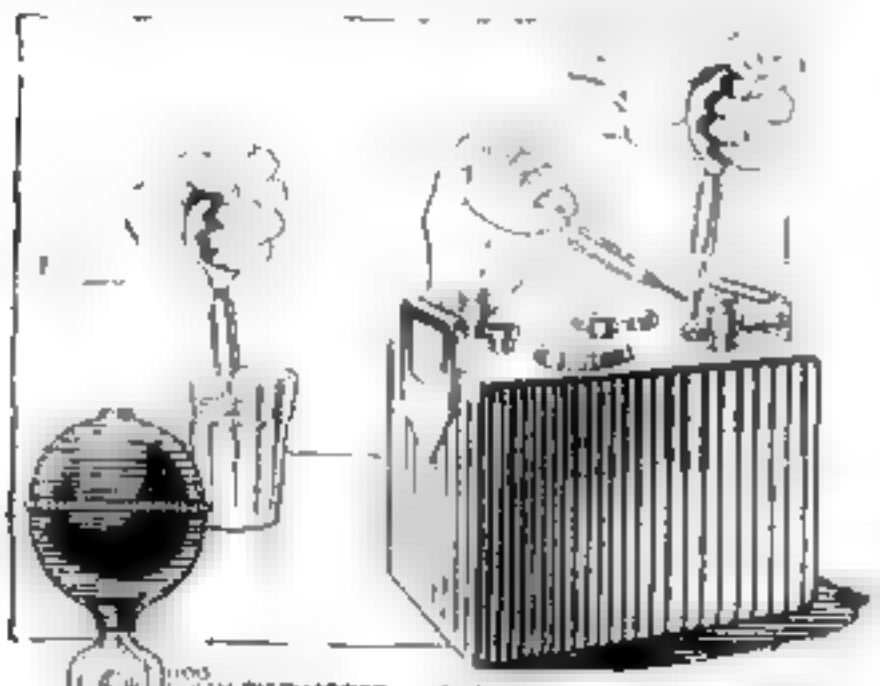
Fig. 6. The holders with foil and paper between them and binding posts on one surface

ment which is used to adjust the crystal-detector to its sensitive receiving con-

dition, and a complete wiring diagram for the entire transmitting and receiving station will be given. The manipulation of the apparatus, the methods of calling and answering and of sending messages, as well as the construction and use of the antenna change-over and the detector-protecting switches will be discussed. The remaining instruments needed for the receiver are even easier to construct than the detector and condenser outlined here. It would be a good plan for the experimenter to complete his transmitter (as described last month) now and the apparatus shown in this article, so that he will be all ready to put his station into complete operation soon after the appearance of the next article. It should be remembered that for exchange of messages between two stations it will be necessary to build two of each of the instruments described, so that each station may be completely equipped and thus prepared both for sending and for receiving

Caring for Storage-Batteries on Automobiles

A WEAK or exhausted battery will cause misfiring in an engine, be-



Adding new solution or water to a weak storage battery cell to test the specific gravity

cause the current voltage is not sufficient to make a good hot spark jump across the spark-gap. A battery becomes weak, or dead, because of some internal defect resulting from short-circuiting, due to the collection of sediment, destruction of insulation and the buckling of the plates; or, perhaps too little attention is given to the recharging requirements which vary with the use of the car. It is best to analyze the character of the driving before finding fault with the battery to see if a too great demand has been made upon it. A doctor or a city salesman, making many stops, will consume more current than the battery will stand, due to the frequent cranking. Continued use of a car at night will place an added burden on the battery to light the lamps, which may equal or exceed the output of the generator going at the speed one travels at night. Under these conditions a battery may be in a completely run-down or discharged condition when tested in the morning. The specific gravity of the electrolyte may drop below 1,150. One of the chief causes of battery exhaustion is excessive cranking.

The hydrometer syringe is used in the manner illustrated in making tests for specific gravity. When refilling the cells with fresh distilled water or putting in a new solution squeeze the bulb, and place the rubber tip in the receptacle containing the solution. The bulb is then released, and the liquid is drawn into the glass tube. Insert the tube in the vent hole of the battery, and squeeze the bulb lightly to eject enough of the contents to fill the cell. Release the bulb and quickly turn the tube to a horizontal position, to keep the solution from dropping on the upper surface of the battery. Press the bulb to expel the remaining liquid, replace the vent plugs and wipe the moisture and dirt from the top of the cell.

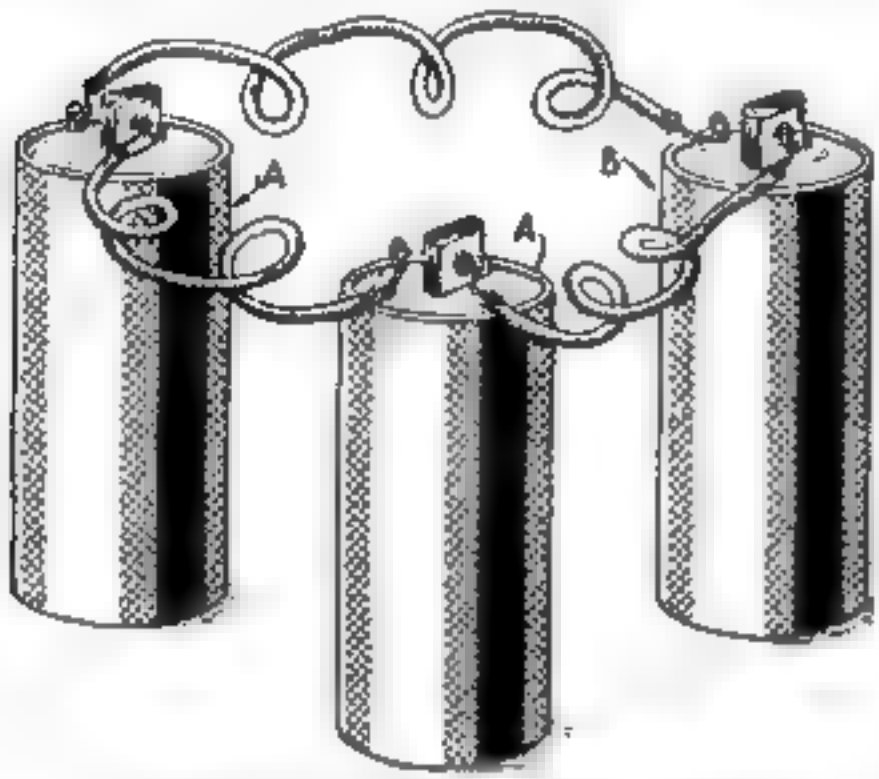
To test the specific gravity, draw in enough liquid to fill the syringe and hold it toward a light. The floating part will show the density by the graduations.

Discarded Type-Cases in the Amateur's Shop

DISCARDED type-cases, obtainable from any printer, can be put to excellent use in the shop of the amateur mechanic. Such cases may be used for keeping screws, nuts, bolts, washers, etc., where they can be easily found. Fasten two or three of them under the work-bench where they will be within easy reach.

A New Method of Reviving Old Dry Batteries

NOW that all sorts of electric pocket flashlights and electric lanterns are common, it is worth while to know that the batteries for them need not be thrown away immediately after the light loses its original brilliancy. When



Three partly exhausted cells are connected, two in series and the third across terminals

a dry cell is so far exhausted that it produces nothing more than a quickly-fading glimmer of light, which it would ordinarily keep at full brilliance, it is usually discarded as worthless. Such batteries may, however, be set aside until a number of them have accumulated; and some of them may be used to revive the others by the following method, which is applicable to the dry battery because it possesses, to a certain degree, the property of reversibility.

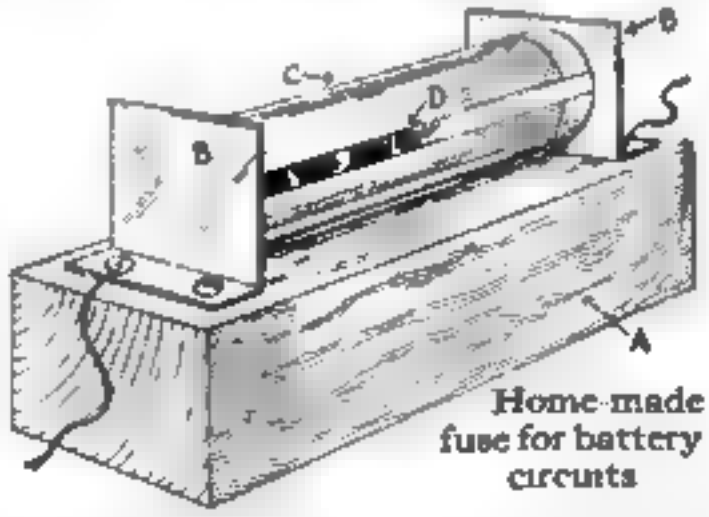
When three partly exhausted cells have been accumulated, connect two of them in series, and the third one across their terminals in reverse series, as shown in the drawing. When this is done, it will be seen that the electromotive force of cells *A* will more than balance that of cell *B*; and a small current will flow through the entire battery, passing through cell *B* in the reverse direction from normal. The reversed cell, therefore, becomes virtually a storage cell, and slowly takes on a charge from the other batteries After being left in this position for a few days, cell *B* may be disconnected and again used in the regular way. A cell thus revived will be as good as new.

More than three cells may be connected; for example, three cells *A*, may be set to reviving two cells *B*; in which case the action will be slower because the electromotive force of the odd cell, *A*, must overcome the internal resistance of five cells instead of three, as in the first case.

Old dry cells for any other purpose may be revived in the same way. They may be tested for exhaustion by connecting them to an ammeter or to some piece of apparatus such as a bell or telegraph-sounder, and comparing the effect produced by one of the old cells with that produced by a fresh cell when connected to the same. As an ammeter puts a cell on practically a short circuit, it should be used quickly to avoid further exhaustion of the strength of the cell. The property of reversibility is not possessed by all types of primary batteries; and it must be borne in mind that this article has reference only to the dry cell.—Edwin C. Wright.

A Home-Made Fuse for a Small Battery Current

THE beginner in electrical science who wishes to demonstrate the action of a fuse on a small scale will find the following a suitable form to use. Make a little wood block *A*, 2 in. long by 1½ in. wide, and fix two brass springs, *B*, one at either end. The screws used to secure these also serve for the attachment for connecting wires. Take a 1-in. length of glass tube, *C*, and cork both ends, pasting a very



Home-made fuse for battery circuits

narrow strip of tinfoil *D*—⅛ in. or less—along the side and covering both corks with a wider piece of foil. The tube can then be gripped between the springs. This forms a good fuse for small currents.

Amateur Trench Electricians

How the soldiers in the French trenches utilize shell cases, brass scraps, and old muskets to spy electrically on the enemy

By George Kenneth End

IN a bombproof dugout under an auxiliary station not far from Fort Tavannes in the Verdun theater of the war, an electrician has installed a crude little wireless apparatus.

This young Edison of the trenches is the leader of a group of expert electricians assigned to one of the most difficult and most dangerous jobs on the front. The laying of wires from the "*poste d'écoute*," "listening station," to the switchboards further back of the lines, the wiring of underground mines so as to afford illumination for the soldier toilers under earth, and constant vigilance over the wires which might at any moment be cut by exploding shells, is his job.

It is useless to lay wires underground along the Verdun front, so three wires are strung for every line connection. These lines are strung from small posts about 7 ft. above ground, the several units of the same line being as widely separated as possible. Thus the chance of having the circuit broken is made comparatively small.

At this particular switchboard, which was about 15 ft. underground, there was telephonic connection with about eight different points along the first lines. Every 20 minutes each of the lines was tested by the operator at the switchboard. When a line was found to be cut a squad of four men was sent out at once to locate the fracture and repair it. They might be called upon at any time of the day or night, for very often when the enemy is concentrating a curtain of shell fire over a section information as to activities in the first lines would be absolutely cut off if it were not for the telephonic communication. Most of the lines are hung parallel to the roads, where they are, of course, exposed to shell fire more than they would be if laid across the fields. The main consideration, however, is to have them accessible to the linemen.

It is not shell fire alone which brings down the telephone wires along the front. The closer to the lines, the cruder becomes the method of hanging the wires; so that a small windstorm or even rain (which invariably follows a heavy bombardment) may put the wires out of commission.

The electrician in question, who had been in this particular section of the Verdun front during four months of the great battle, constructed during his spare moments a device for electrically eavesdropping in the enemy's trenches. For the success of the device he was decorated with the *Croix de Guerre*. He had very little equipment at his disposal, so he utilized, for the most part, pieces from the artillery scrap-heap. Through the use of his trench dictaphone several gas-attacks of the enemy were apprehended in time to make preparations against them.

During the night the electrician arranged in the enemy's barbed wire a series of discharged "75" shell-cases containing microphones, to which he connected wires terminating in the French trench where batteries furnish current for reproduction of the sound waves on telephone receivers. A ground connection is made to carry the "return" current

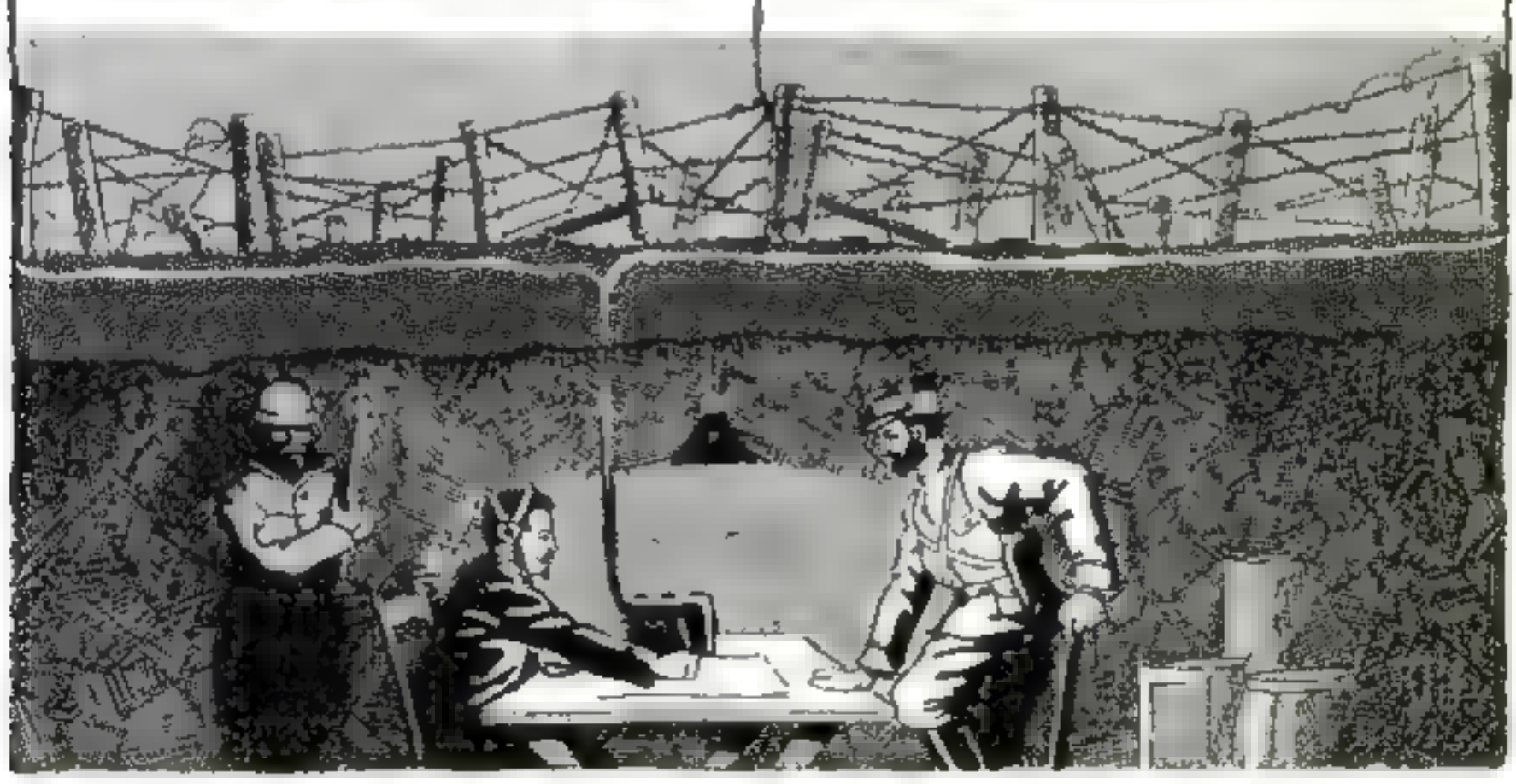
It is true that the closer one gets to the front the less general becomes his perspective of the war. The men in the first line trenches see the war sifted down to the few feet of trench where their guns are resting. News from other parts of the front is generally 48 hours late in reaching these men. If a soldier who has been holding down his few feet of trench at Verdun is assured that his countrymen on the rest of the front are doing the same he is much encouraged. This electrician has made it possible for them to receive the daily *communiqué* an hour after it is transmitted from the great wireless station of the Eiffel Tower in Paris He did some more rummaging

around the artillery scrap-heap, detached a few parts from an old musket, cut some strips from a brass "75" shell-case, bought a small piece of detector-crystal, and in a short time was sending a messenger out soon after midnight every night to take to the men in the first lines the day's news.

At midnight of the date of the interview the *communiqué* was a long one, being the first news of the French offensive in Picardy which had just begun. A messenger took the glad tidings back to his brothers in the trenches. Then the electrician adjusted the instrument so that it intercepted messages sent out by some German portable field wireless apparatus. The German spark is pitched very high and musical, while the French is dull and staccato. A message sent out from an aeroplane was intercepted also by the crude but practical receiving instrument.

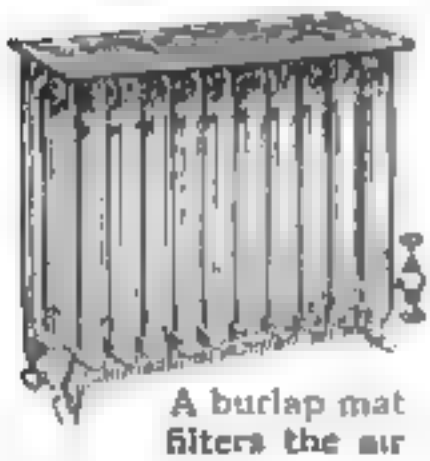
For military purposes the wireless is not used as much by the French as by the Germans. The French, wherever possible, use the telephone instead; and along some parts of the front they have established underground lines impregnable to shell fire. The French have closed automobiles equipped with complete telephone switchboards, so that temporary exchanges may be established at short notice wherever they may be needed. Where the portable wireless is used on the French front it is carried on a motor-tricycle affair so that it may be taken very close to the first lines.

In the recent offensive on the Somme electricity was a very potent aid to the French success. The village of Dompierre, which before the offensive was in the hands of the Germans, had been mined by the French from one extremity to the other. The principal excavation



under the village had an area of some 50 square meters (about 500 sq. ft.). It was a task which took the French over two months to accomplish, for there were immense difficulties encountered in the way of avoiding enemy mining parties and transporting material necessary for making the work secure. As the work progressed, electric wiring was installed for illuminating the dark recesses of the excavation. Finally the large cavern of the mine under the village of Dompierre was stored full of explosives—enough, in fact, to blow the entire village to atoms. Electric fuses were installed, from which underground wires led back to General Headquarters. Thus the general of the division, by pressing a small electric button ten kilometers distant, blew up the German village of Dompierre. He heard the explosion five seconds later and knew that the first stroke of the great Picardy offensive had been a success.

A Simple Plan to Avoid Clouded and Grimy Ceilings



A burlap mat filters the air

IN many residences and public buildings where hot water or steam radiators are used, the wall above and behind the radiators and also the ceiling above them eventually become clouded and grimy. Why? Because the air of the rooms is drawn to these warmest points, rising between the coils and going directly upward before spreading out to circulate through the rest of the room. As they strike the wall and ceiling the columns of warm air deposit their dust.

A remedy was found by one housekeeper who made simple mats or covers of coarsely woven burlap in colors to harmonize with the furnishings. Placed on the radiator these open-weave hemmed cloths allow the air to rise through them, but sift or filter out the dust, which is removed by an occasional washing.

To Prevent Asphaltum in Cans from Evaporating

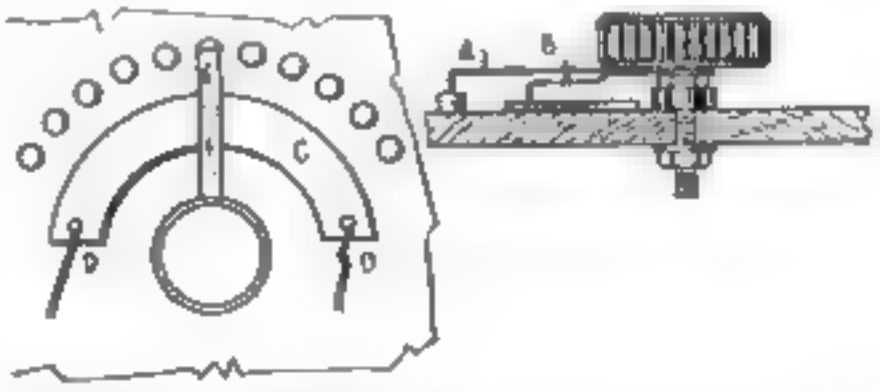
ASPHALTUM is used extensively about electrical apparatus and where anyone has to do with the making up of coils, and the like, a can of this material will be found at hand. The brush and liquid will likewise be found in a condition that renders them unusable until thinned with drier. Just an ordinary oil-can makes a convenient holder for the liquid and brush. The handle of the brush is inserted in the spout, as shown, where it keeps the brush part in the liquid. Air cannot enter, hence there is no evaporation. This holder is especially useful for the home work-shop where the asphaltum is used only occasionally and is kept in small quantities. The brush is kept soft and in a workable condition.

The paint brush suspended within the oil-can holder

Making an Inductance Switch for Radio Work

WHEN using switches it often happens that trouble is found in making connection to the lever. Soldering is about the best method, but it is often inconvenient. By using the device shown in the sketch this trouble will be avoided.

In the drawings, *A* is the regular brass arm of the switch; the arm *B* is



Small switch made of brass strips to form connections to the lever contact points

fastened directly under the arm *A* and revolves with it, so that when *A* is on a switch point *B* is making contact with the brass strip *C*.

The piece *C* may be cut from sheet brass or copper. It is held to the board by the posts *D* from which the connection is taken.

What Radio Readers Want to Know

Interesting and Instructive Questions and Answers

Construction of a Transformer; License for Experimental Station; Operation of Alternating Current Arc Sets

E. D., St. Joseph, Mo., inquires

Q. 1. Please give the details of construction for a 1-K.W. open core transformer and advise how far I may expect to send with it?

A. 1. An efficient transformer that will give a secondary voltage of about 18,000 when connected to a 60-cycle source of current supply may be constructed in the following manner: Assemble a core 3 in. in diameter, 25 in. in length, composed of a bundle of wires about No. 30 B&S gage. Care should be taken to secure the best grade of Norway iron. The core is then covered with two layers of Empire cloth after which it is wound with two layers of No. 10 D.C.C. wire, each layer having 220 turns. The entire primary winding is then inserted in a hard rubber or micanite tube and properly mounted on end supports. The tube should have ¼-in. walls.

The secondary winding is composed of a number of pancakes, the inside dimensions of which are ½ in. greater than the primary tube. The secondary winding is then composed of 38 sections, ¾ in. in width, each pancake comprising 1,125 turns of No. 32 S.S.C. wire Just previous to the winding of the individual pancakes the wire should be soaked in hot paraffin. The pancakes are of course separated by insulating washers, such as fiber or hard rubber disks. This transformer may be connected to 60-cycle, 110-volt mains direct, without the insertion of a primary reactance coil. At the restricted wave of 200 meters you will not be able to use the full output of this transformer, as the required condenser for the secondary winding will have a value of approximately .02 microfarads, which is double the value that may be used at 200 meters. This transformer should permit a sending range of 50 to 100 miles during the daylight hours.

Q. 2. Under what conditions can a license be secured for the operation of an arc set for undamped waves?

A. 2. It is doubtful if the U. S. authorities will issue a license certificate for an experimental station of this type unless the license is requested by an investigator of recognized standing whose work may be of substantial benefit to the art You had better address your inquiry to the Commissioner of Navigation, Washington, D. C., stating the purpose for which you desire such license. Also keep in mind that arc generators do not operate well at wavelengths below 2,500 meters. Consequently you would be required to operate your station at wavelengths that may interfere with commercial traffic.

Q. 3. How far will an arc set having ½-in. carbons connected to 110 volts alternating current transmit?

A. 3. Alternating current arc sets do not operate satisfactorily and it is feared that you will not be pleased with the results obtained. It is the custom to use 500 to 1,500 volts direct current, but good results can not be obtained by a simple arc gap. The gap must be enclosed in a chamber and fed with hydrogen or illuminating gas and in addition blow-out magnets are mounted at a right angle to the arc to increase the difference of potential. The subject is fairly well discussed in Zenneck's "Wireless Telegraphy."

Audion Circuits of a "Beat" Receiver; Equipment for a 5-Mile Range; Quenched and Rotary Gaps

J. I. I., Monroe, Mich., writes:

Q. 1. Is it considered practical to use an Audion or an Audiotron in the circuits of a "beat" receiver for wavelengths from spark stations lying between 150 and 1000 meters?

A. 1. Yes; but it is sometimes found difficult to keep the Audion in oscillation at the lower range of wavelengths. The circuits of the De Forest Ultraudion are said to overcome this difficulty; but with other circuits better results are secured at wavelengths in excess of 2,500 meters. The Ultraudion circuits are published in the Proceedings of the Institute of Radio Engineers.

Q. 2. With an aerial 50 ft. in length, 20 ft. in height and an earth wire 100 ft. in length, what range could be expected from the following instruments? A 2-in. coil, 14-volt battery, suitable condenser, small quenched gap and helix. The foregoing apparatus is to transmit to a receiving station comprising a tuning coil, galena detector, 2000-ohm receivers and condenser.

A. 2. If the receiving apparatus is well designed, you should be able to communicate to a distance of five miles provided local conditions do not interfere.

Q. 3. Is a quenched gap in series with a rotary gap more efficient than the use of rotary gap alone?

A. 3. Generally, no; about the only value of this combination is the fact that the rotary gap allows one to obtain a high spark note from a 60-cycle source of current supply. In a well-designed set the quenched gap gives the greater value of antenna current; but for ordinary amateur working the rotary gap fulfills the requirements. In the Clapp Eastham Hytone gap the advantages of both types of spark dischargers are combined in one construction.

Receiving Wavelength

C. H., Farmington, Conn., inquires

Q. 1. Approximately to what wavelength can I adjust with a tuning coil 20 in. in length, 2½ in. in diameter, wound with No. 30 bare wire? The remainder of the apparatus comprises a condenser, a galena detector and 1500-ohm telephones.

A. 1. With the average amateur aerial this tuning coil will permit adjustment to wavelengths inclusive of 6,000 meters, and by the addition of a condenser in shunt to the terminals of the detector circuit, the wavelength can be further increased.

Damped Wave Reception on Oscillating Audion

J. B. E., Newark, N. J., writes:

Q. 1. Referring to the article by W. Ross McKnight in the April, 1916, issue of the *Popular Science Monthly* (page 613) I would like to know if this equipment will respond to both damped and undamped waves, that is, will the equipment respond to ordinary spark stations without change of circuit.

A. 1. The receiving apparatus described by Mr. McKnight is applicable to the reception of both damped and undamped oscillations, but is more sensitive with the latter. When the audion is in a state of oscillation, an impure beat-note is produced in the reception of damped oscillations. The result is that the spark note of the distant transmitting stations is distorted, the signal sound being of different character and usually lower than the normal note. The receiver described by Mr. McKnight was built expressly for the reception of long wavelengths and will not give good results on the shorter wavelengths in the vicinity of 600 to 1,000 meters.

Long Distance Stations

S. W. D., Hamilton, Ohio, inquires:

Q. Please give the wavelength, type of transmitting apparatus, and the call letters of as many as you can of the following Transatlantic stations

A.

Name Station	*Call Letters*	*Type of Apparatus*	*Wavelength (Meters)*
Hanover, Germany	OUI	Goldschmitt High Frequency Alternator	7400
Nauen, Germany	POZ	Joly High Frequency Alternator	9400
Eiffel Tower, Paris	—	Damped and Undamped Transmitters, Type Unknown	2500 (for time signals)
Honolulu, T. H	KHL	Poulsen Arc Generator	10000
Darien, C. Z.	NBA	Poulsen Arc Generator	6000–10000
Colon, Panama	NAX	Quenched Spark Transmitter	300, 600, 1600
Glace Bay, N. S.	WSS	Marconi Rotary Disk Discharger	7925
Poldhu, England	ZZ	Marconi Rotary Disk Discharger	2800
Tuckerton, N J	WGG	Goldschmitt High Frequency Alternator	7400
Siosconsett, N. J.	WSC	500 Cycle Transmitter 2 K.W.	300, 600
Sayville, L. I.	WSL	Joly High Frequency Alternator	9400
New Brunswick, N J	WII	Marconi Rotary Disk Discharger	8000, 15000
Lake Bluff, Ill.	NAJ	Poulsen Arc Generator	6000

Strength of Received Signals Where Connecting Leads Are Long

D. P. D., Limon, Colo., inquires:

Q. 1. Will there be any loss in the loudness or in the strength of signals when the receiving apparatus is located 20 to 25 ft. from the lightning switch, the latter being erected on the outside of the building, and the receiving instruments placed on the opposite side of the room to that at which the lead is brought in from the lightning switch?

A. 1. No; it is of course desirable to make the connecting lead as short as possible, but the loss in efficiency will not be appreciable

Q. 2. What effect will it have on the strength of wireless telegraph signals if the antenna and ground wires are run parallel; that is to say, are twisted together for a distance of from 20 to 25 feet from the lightning switch to the receiving apparatus?

A. 2. The twisted cable will have distributed capacity and will act as a condenser connected in shunt to the primary winding and consequently will occasion a loss in the strength of the signals. It would be better to separate these wires by a distance from 6 to 8 feet

Q. 3. My receiving aerial is 60 ft. in length composed of five wires spaced three feet apart. It points east and west. The lead-in is taken off the east end and extends to the lightning switch which is mounted on the outside of the window of the second floor. The distance from the point where the lead-in is taken off east to the lightning switch is 90 ft. Could I get better results if the lead-in was taken from the center of the aerial instead of from the end?

A. 3. For general receiving purposes it had better remain as it is.

Q. 4. Will the above aerial be satisfactory to receive from the amateur stations, providing a variable condenser is used to adjust the shorter wavelengths?

A. 4. Yes, if the condenser is in series with the antenna

Q. 5. What is the wavelength of this aerial?

A. 5. The wavelength is close to 150 meters.

This One

C6JQ-T6J-64J8

Simple Method of Remagnetizing Magnets

REMAGNETIZING magnets is a very simple operation for which about 100 ft. of No. 18 copper wire, a 12-volt storage-battery current and a small pocket needle compass are required. Furthermore, the magnet may be tested for strength after it has been removed from the magneto and again tested after it has undergone the remagnetizing process by means of another simple equipment consisting of a block of wood, a bar of iron, a flat iron-plate, a spring-balance scale and a piece of non-conducting cord. Both of these equipments as used are shown in the two accompanying drawings.

The method of procedure after removing the magnet from the magneto is first to test its strength. This is accomplished as shown in Fig. 2. The block of wood is held in a vertical position in the jaws of a vise or other handy object and a rod with a hook at its end is slipped into a staple and plate screwed to the top of the block of wood. A spring-balance scale with a ring at the top is suspended from the rod, the magnet being hung from the scale by a strong cord but with the two ends touching a clean flat iron-plate laid on the bench beside the vise. On account of the magnetism remaining in it when removed, the magnet will tend to adhere to the flat iron-plate; it can be pulled away by pushing up on the rod, at the same time registering the pull on the spring-scale. After this has been done several times and the pull registered each time, calculate the average pull to release the magnet and the area in contact with the flat iron-plate. If the pull required is less than 30 lb. per square inch, the magnet is weak and should be remagnetized as shown in Fig. 1.

The 100 ft. of wire should be formed into two equal coils into which the legs of the magnet can be inserted. The polarity of the coils should be tested by means of the pocket needle compass and the current from one of the dry cells, the needle being attracted by one coil and repelled by the other. Then test the magnet itself by means of the compass and place the positive magnet leg in the positive coil and the negative leg in the negative coils. This is of great importance; for if the positive leg is inserted in the negative coil, the polarity of the magnet will be reversed and it will become useless. Next wire up the end of the coils with the three cells as shown, with a break in the circuit. The magnet is remagnetized by alternately bringing together the ends of the wire at the circuit break and then pulling them apart. This operation should be continued for about five minutes, after which the magnet should be tested as described above. If the magnet does not show enough strength the first time, the remagnetizing process should be repeated until it does. This

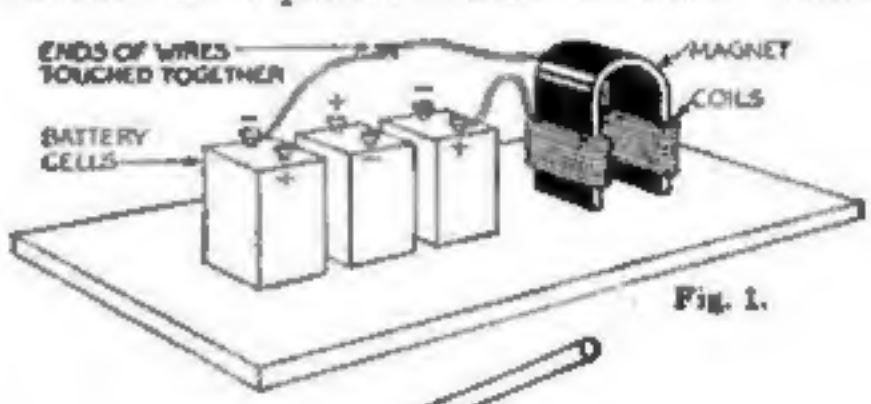


Fig. 1. Method of remagnetizing magnets
Fig. 2. Calculating the strength of the magnet

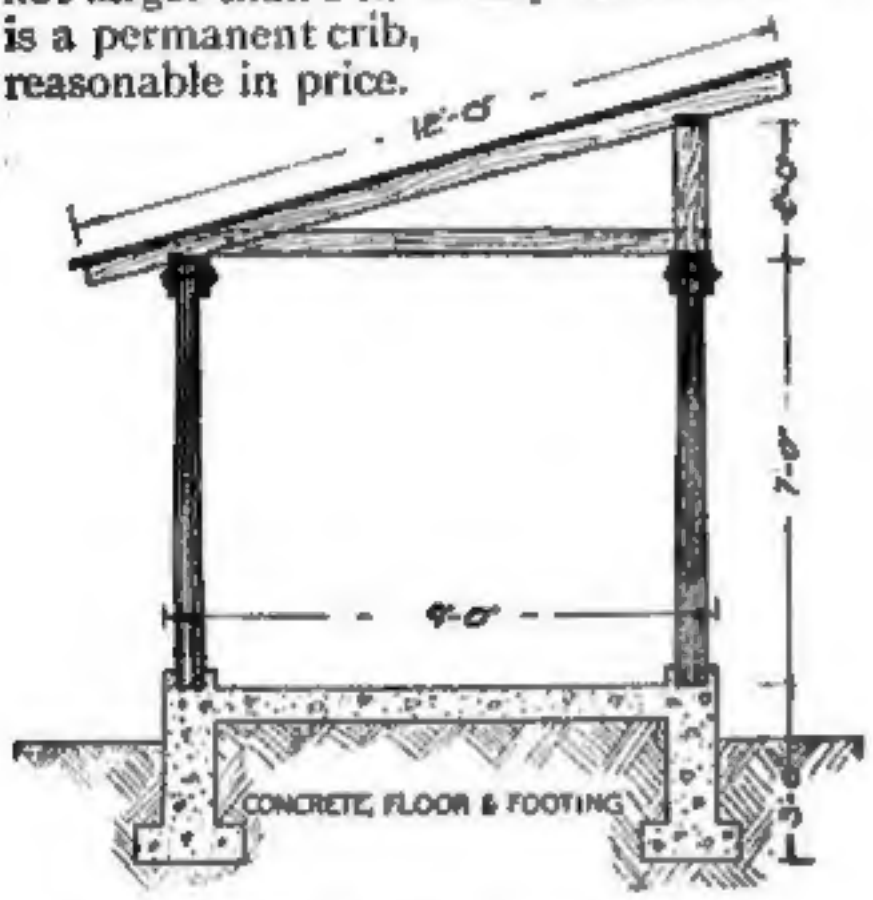
accomplished, an iron keeper should be placed across the magnet legs so that its strength will not be dissipated through the tendency of the magnetism to jump the air gap between the poles if left free.—JOSEPH BRINKER.

The Telephone Receiver for Wireless Apparatus

THE telephone receiver used in wireless telegraphy is a very sensitive instrument, and gives signals from exceedingly small amounts of electrical power passed through its magnet windings. Nevertheless, measurements have shown that only about one one-hundredth of the power applied electrically is actually converted into sound-waves.

The Construction of a Small Concrete Corn-Crib

THE roof of this corn-crib is made of lumber and the side walls and floor are of concrete. The walls consist of concrete fence posts—the ordinary kind with 3-in. tops and 6-in. bases. The foundation and floor of the building are of concrete mixed in the proportions of 1 part cement, 3 parts of sand and 5 parts gravel or stone broken in pieces not larger than 2 in. in any dimension. It is a permanent crib, reasonable in price.



Corn-crib made with concrete posts for the side walls and with solid concrete floor

The posts are anchored at the bottom to the concrete and at the top are securely clamped together with a box-plate made of three 2 by 6-in. pieces bolted together every 4 ft. over the top of the posts. Along the front side of the crib there is a short studding about 2 ft. long which supports the roof and makes a convenient place where the grain may be thrown in the crib. The rafters are spiked to the plates and are set on 2-ft. centers. Across the top of the posts from plate to plate a cross-tie is run from each rafter. This makes the crib solid and will prevent the sides from spreading.

In the center of the crib criss-cross braces of wire should be put in, twisted taut and fastened to bolts at the foundation line. Cover the roof with shiplap for sheathing, making a tight and smooth foundation for the three-ply asphalt-and-felt prepared roofing material which is laid lengthwise of the building.

The posts should be of a 1-to-3 mixture of cement and sand made into a sloppy consistency before pouring it into the forms. One sack of cement will make about 8 posts, weighing 90 lbs. each. There should be three ¼-in. round steel rods placed in the center of each post to reinforce it. For an 800-bushel crib of a size 9 ft. by 32 ft. the following amounts of materials will be required:

13 barrels cement for floor and foundations
6 cubic yards of clear sand
10 cubic yards of coarse gravel
80 concrete posts
2 dozen bolts ⅝ by 8 in.
300 ft. of 2 by 6 in. material for box-plates 16 ft. long
100 ft. of 2 by 4 in. material for cross-ties 9 ft. long
150 ft. of 2 by 4 in. material for rafters 12 ft. long
40 ft. of 2 by 6 in. material for studding 2 ft. long
450 ft. of shiplap sheathing lumber
4 squares of three-ply roofing felt.

Experiments with Antennas of Varying Lengths

AT some wireless stations very interesting results have been secured by providing a number of single-wire aerials of various lengths and extending them in different directions from the operating room. By the use of single-pole, double-throw switches these may be connected to the receiving tuner or directly to the ground, or left open-circuited. Various combinations are found to give good results in receiving from particular stations, depending upon the direction and wavelength of transmission.

It has sometimes been found valuable to ground one wire through tuning inductance while receiving on an entirely separate aerial.

Those of us interested in science, engineering, invention form a kind of guild. We should help one another. The editor of The Popular Science Monthly is willing to answer questions.

A Detachable Conning Tower Lessens Submarine Risks

The entire crew get into the conning-tower, detach it from the body of the submarine, and regulate by the windlasses, the speed of the ascent of the tower as its buoyancy raises it to the surface where it signals for help. The body of the submarine can be recovered by means of the cables